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DESCRIPTION OF THE WORKS OF THE BETHLEHEM IRON COMPANY.

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Less than three years ago The Bethlehem Iron Company broke ground to carry out the writer's proposition for the introduction and erection of complete hydraulic forging machinery for the manufacture of the largest guns and the heaviest shafting and armor plates; to erect a plant long needed in the United States, to make the country independent in the possession of the means of supplying the nation with the most powerful guns and of equipping her ships with the most efficient shafting and armor.

The company that undertook this great work was conceived as early as the year 1857, when the senior partner of the firm of A. Wolle & Co., of Bethlehem, procured a charter, dated April 8, 1857, for a company styled "The Saucona Iron Company."

By an Act of Legislature, dated March 31, 1859, the corporate title of the company was changed into that of "The Bethlehem

Rolling Mills and Iron Company," and the services of John Fritz, of Johnstown, Cambria County, Pennsylvania, were secured to superintend the construction of the works and the subsequent manufacture and production.

Its first Board of Directors, chosen June 14, 1860, was composed as follows: President, Alfred Hunt, of Philadelphia. Directors, Augustus Wolle, of Bethlehem; Asa Packer, of Mauch Chunk; John Knecht, of Shimersville; John Taylor Johnston, of Central Railroad of New Jersey; Charles B. Daniel, of Bethlehem; Charles W. Rauch, of Bethlehem; Secretary and Treasurer, Charles B. Daniel.

The present Board consists of John Knecht, of Shimersville; Rob't H. Sayre, of South Bethlehem; Joseph Wharton, of Philadelphia; E. P. Wilbur, of South Bethlehem; W. W. Thurston, of South Bethlehem; Rob't P. Linderman, of South Bethlehem; George H. Myers, of South Bethlehem. The officers are: President, W. W. Thurston; Vice-President, Rob't P. Linderman; General Manager, Rob't H. Sayre; Chief Engineer and General Superintendent, John Fritz;. Assistant Superintendent, R. W. Davenport; Secretary, Abraham S. Schropp; Treasurer, C. O. Brunner.

These works are situated at South Bethlehem, Northampton County, Penna., on the Lehigh river, 87 miles from New York by way of the Lehigh Valley Railroad and Central Railroad of New Jersey, and 55 miles from Philadelphia via the North Pennsylvania Branch of the Philadelphia and Reading Railroad. They are connected with the anthracite coal regions by the Lehigh Valley and other railroads, various roads and their connections affording ample facilities for the cheap transportation of fuel and ores to the works, and convenient outlets for the distribution of the varied products.

At the present time the works consist of offices, boiler houses, blast furnaces, puddle mill, merchant steel mill, Bessemer department, department of construction and repairs, ordnance and armor plate department, laboratories, mines, quarries, etc.

The buildings have been erected from designs made here. They are of hard gray sandstone from adjacent quarries, and brick, and the roofs, covering about 18 acres, are of slate from the vicinity.

OFFICES.

The offices are roomy, well lighted, and equipped with modern appliances and well-lighted drafting rooms.

BOILER HOUSES.

The boiler houses are detached, and conveniently arranged for the delivery of fuel, and the boiler settings peculiar, to provide for expansion in any direction without subjecting the boilers to any injurious strains.

BLAST FURNACES.

No. 1 furnace was commenced in 1860 and completed and put in blast in January of 1863; No. 2 was completed in 1867; in 1868 the furnace of the Northampton Iron Company was purchased and put in blast during December of that year under the name of No. 3, and after running 16 years was dismantled; furnaces Nos. 4 and 5 were put in blast in March, 1876, and March, 1877, respectively; furnace No. 6 was completed in 1883; furnace No. 7, purchased in 1879, is situated at Bingen, on the Philadelphia and Reading Railroad, about six miles from Bethlehem.

Furnace.	Height.	Bosh.	Hearth. Feet.	Hearth. In.
No. 1	61	15½	8	6
" 2	70	16	10	0
" 4	70	16	10	0
" 5	70	16	10	0
" 6	70	19	10	0
" 7	65	16	10	0

These furnaces are widely known for their excellent Bessemer iron. The fuel used in smelting is anthracite coal from the upper Lehigh region, with a mixture of Connellsville coke. A choice variety of hematite and magnetic ores from the most celebrated mines at home and abroad allows of an excellent pig for making Bessemer and open-hearth steels of a very superior quality. A railway connects the furnaces with the converters for the transportation of fluid metal, thus permitting the making of Bessemer steel by the direct process. The total annual capacity is 160,000 tons.

The engine house, separated from the furnaces by the stock house, is a massive stone building 60 × 327 feet, erected with the special view of protecting the blowing machinery from the dust and dirt of the furnaces. It contains seven horizontal blowing engines, five of which are compound; steam cylinders, high pressure, 30 inches diameter, low pressure, 54 inches diameter, 80 inches stroke; blowing cylinder, 80 × 80 inches. The other two engines are single condensing; steam cylinder, 54 × 80 inches, blowing cylinder, 80 × 80 inches.

The blowing engines of the horizontal compound type work at a high speed and under high pressure of blast with a degree of smoothness and noiselessness that is rarely observed in a blowing engine. A strong feature in these engines, and one now generally recognized by blast-furnace engineers, is their capacity of blowing as high a pressure as 20 pounds of air, this pressure sometimes being necessary to save the furnace and obviate expensive delays.

The cast house of each furnace is at a right angle and forms a wing to the stock house. The spaces intervening between the cast houses are used for cinder yards on one side, while on the other are located the boilers and hot-blast stoves.

The newest furnaces are provided, each with three Whitwell fire-brick regenerative stoves, which give excellent economical results. These stoves are 20 feet exterior diameter and 60 feet high.

The stock house is common to all the furnaces, and is a continuous building running parallel with the line of furnaces and to their full extent. It is 61 feet wide. A double track runs the length of the building on trestles 12 feet above the floor level. The floor is divided off into spaces on each side, and a central aisle renders all parts accessible.

THE PUDDLE MILL.

This mill contains three double double, four double, and one single puddling furnace, with boilers over furnaces. It was originally built for the production of iron rails, and since they have no longer been in use, has been noted for the high quality of merchant iron and muck-bar produced. The mill has recently been used for the production of muck-bar exceedingly low in phosphorus, which is used for remelting at the open-hearth furnaces for the production of the high quality of steel necessary for ordnance and shafting work.

MERCHANT-STEEL MILL.

The merchant-steel mill is principally used for the rolling of smaller sections of rails, and special grades of Bessemer steel into billets, which are sold to manufacturers for the production of merchant bar, wire rods, axles, etc. The rolling of iron shapes, principally used for construction in the works, is an important product of this mill.

BESSEMER DEPARTMENT.

Steel Mill.—This mill is a large and massive stone structure, having numerous and uniform arched openings in its sides, and an

iron and slate roof with a continuous lantern. The total length of the nave is 1512 feet, and its width is 111 feet. The transepts are also 111 feet wide, and their total length, including the crossing of the nave, is 386 feet. The clear height is 29 feet. This building runs longitudinally east and west, parallel with the Lehigh Valley Railroad. In the western or upper portion of the mill is located the converting department, consisting of four 7-ton vessels. These vessels are arranged in a straight line across the mill, an iron platform supported on cast-iron columns surrounding them. Back of the vessels stand the iron and spiegel cupolas; they are supplied with double platforms, one above the other, commonly called the charging and tapping floors. These floors communicate with the vessel platform and with each other by means of iron stairs. Three vessels are worked alternately, while one is off for repairs; the iron cupolas are run four on and four off; the spiegel cupolas are run two on and two off. This method of working facilitates repairs and prevents the necessity of any excessive repairing or protracted delays. The vessels are wrought-iron shells, eight feet in diameter; the body is completely lined with natural stones of mica schist, roughly hewn to shape, and the nose is lined with fire-brick. A vast number of experiments were tried before a natural stone could be found that would not either flake off under the heat of glazing or become rapidly denuded. The excellence of this stone depends upon its mechanical structure, which of course is a thing hardly capable of description. Excepting some not expensive repairs to the nose, one of these linings is good for 30,000 tons of ingots. In the old plant, 54,000 tons were made on the linings of the two vessels without the removal of any stones excepting in the nose and a few at the bottom joint. The vessel bottoms have 17 fire-brick tuyers, with 12 holes, three-eighths inch each. Between the tuyers are set on end bricks like the blast-furnace lining brick, as near together as they will stand. The small space left between the bricks and tuyers is rammed with ordinary gannister bottom stuff, and so small is the total quantity of water in the bottom that it needs oven-drying only four hours; the bottoms stand 12 to 14 heats quite uniformly. The output of the converting department averages 4000 tons of ingots per week of eleven shifts; the plant has been worked at a higher rate of production. The annual capacity is 225,000 tons. The heats of ingots run from seven to eight tons according to the weight of rail. Fourteen-inch ingots are bloomed

down to seven inches square, and cut into single and double rail blooms for the rail mill. The stock ladles, molten metal, ingots, etc., are moved by a system of narrow-gauge tracks. This system, by means of frequent turn-tables, switches and hydraulic lifts, offers a complete and convenient conveyance. The casting pits and handling floor are under complete command, with a systematic arrangement of hydraulic cranes.

The blowing machinery is located in the upper transept, next the railroad. There are two Bessemer blowing engines of the following dimensions: The smaller has two steam cylinders 36 × 60 inches, coupled direct with two blowing tubs 48 × 60 inches. The blowing tubs are placed back of the steam cylinders and on the same bed-plate; the steam cylinders are coupled on their forward end through cross-heads and connecting rods to a fly-wheel shaft, whose cranks stand at right angles. The larger engine has two steam cylinders 56 × 66 inches, and two blowing tubs 60 × 66 inches arranged like the smaller. The smaller was the original engine, but, proving inadequate to the demands of the increased plant, it has been replaced by one more powerful, and is now used as a reserve or emergency engine. The large blowing engine running with 50 pounds of steam is capable of maintaining a blast pressure of 40 pounds of air. The cupola blast is obtained from four No. 7½ Baker blowers, coupled direct to the shaft of a compound engine running 90 revolutions.

The blast pressure at the blowers is about 1¼ pounds, and twelve ounces at the tuyers. Another compound engine directly coupled with four blowing tubs is kept in reserve for the cupolas.

A Worthington duplex and two Worthington compound duplex pumps are also located in this transept, and supply a water pressure of 300 pounds to the square inch for the operation of cranes, hoists, etc.

In the opposite transept are two Pernot furnaces, with their accompaniments. Just outside this transept is the ladle-house, supplied with a number of short tracks and turn-tables. The freshly lined ladles are placed on cars and run into position on these tracks; when in position a cap is lowered, forming a combustion chamber of the ladle, and a stream of gas and air, in regulated proportions, admitted through the center of the cap, causes more rapid drying and hotter ladles than could be obtained by the old method of building fires in them. The number of ladles required is considerably reduced by this method.

The vessel-bottom repair shop is located in the upper end of the mill, and is furnished with hydraulic cranes for handling and ovens for drying.

At this end of the mill a brick foundry has been erected on the south side and adjoins the mill. This foundry is used for the manufacture of ingot moulds, the consumption being 6 to 8 per day. The equipment consists of a cupola and two power cranes.

In the main portion of the mill, just below the pits and handling floor, are six Siemens reheating furnaces. Three furnaces are placed on each side, with hydraulic cranes for charging and drawing the ingots. Centrally, between these furnaces and under command of the hydraulic cranes, run two narrow-gauge tracks, one running to the casting pits, the other to the blooming train. There are two blooming mills, two engines, and three sets of rolls. The smaller engine is 36 by 60 inches, coupled direct to two sets of three high 32-inch rolls. Both sets are supplied with tables operated by power and controlled by two levers at one point. The large mill is also three high; the rolls are 48 inches diameter and 10 feet long; the engine is 65 inches by 8 feet, with 90-ton fly-wheel; this mill is similar to the smaller, but handles a larger ingot. From the blooming mill the ingot passes to steam hammers, is cut into rail-blooms, and charged into the rail-mill heating furnaces.

These furnaces (four in number) are similar in construction to the blooming mill furnaces, varying only in size, and are located immediately below the blooming mill. The rail mill consists of three sets of rolls; the engine is an upright compound, 36-inch high pressure, and 56-inch low pressure cylinders, 50-inch stroke; the rolls are 24 inches, three high. The rail passes from the rolls to the hot saws and thence to automatic hot straighteners, hot beds, cold straighteners, drill presses, and then to a line of driven rollers, which carry the rails to the cars for shipment.

A new 28-inch mill rolls heavy sections and long lengths. This train is driven by three high-speed compound engines on one shaft, connected with the middle roll and driving direct. The aggregate power of these engines is 8000 horses. The necessary tables are of novel design and are worked automatically by water or air.

In the heating furnaces of this department, a gas made from crude petroleum oil is used for fuel at the present time, instead of coal gas made in Siemens producers, as was originally the case.

DEPARTMENT OF CONSTRUCTION AND REPAIRS.

This department includes pattern, foundry, machine and smith shops, for construction purposes and the necessary repairs.

The *Machine Shop* is a stone structure 253 by 64 feet, containing lathes, planers, boring mills, gear cutter, drill presses, shapers, slotting and straightening machines, and pipe cutters, among which are the 120-inch planer, a 16-foot boring mill, three heavy lathes and two large universal drills—one having a span of 14 feet.

The *Foundry*, also of stone, is 107 feet by 64 feet, and forms an L with the machine shop. It is supplied with two cupolas and three powerful cranes, and is thoroughly equipped for all the necessary work.

ORDNANCE AND ARMOR-PLATE DEPARTMENT.

This department, now in operation, when completed, will comprise gas producers, open-hearth furnaces, fluid compression apparatus, soaking pits, hydraulic forging presses, plate rolling mill, crucible furnaces, hydraulic and pneumatic cranes, a 125-ton single-acting steam hammer, bending press, oil-treating and annealing shops, and machine shop.

The *Open-Hearth Furnaces* will have a capacity for casting ingots of 100 tons.

The *Hydraulic Forging Presses* will produce the largest forgings required for ships of any tonnage thus far designed, and for guns of the largest caliber now in existence. A specialty will be made of hollow forgings of large dimensions.

The *Plate Rolling Mill* will be capable of supplying all probable demands for rolled plates of every description.

The *Pneumatic and Hydraulic Cranes* have a capacity of from 25 to 150 tons.

The building containing the open-hearth furnaces, forging presses, fluid compression apparatus, and plate mill is 1155 feet long by 111 feet wide, with transept and annexes for engines, gas producers, etc.

The *Oil-treating and Annealing Shops* are conveniently arranged for economical treatment of heavy gun and other forgings, and of armor plates.

The *Machine Shop* contains lathes, planers, boring mills, slotters, drilling machines, shapers, etc. Among these are: a planer in which 13 feet by 13 feet by 50 feet 10 inches can be planed; 10-foot face-plate

lathe; boring mills of the most recent design, and some of the most powerful lathes in existence. The building is 641 feet in length by 116 feet in width.

The traveling cranes are of the pneumatic type, 60 feet span, and from 25 to 100 tons capacity.

The shops are well lighted by electricity, and the entire plant supplied with efficient rail communication and adequate rolling stock.

The casting and forging presses were manufactured by Sir Joseph Whitworth & Co., of Manchester, England, and designed by Mr. Gledhill, Managing Director of that firm; the heavy tools were constructed from designs by Mr. Gledhill and Mr. Fritz; and all erected under the latter's direction.

In the designing and erection of the hammer plant for making armor plates, the plans of Schneider & Co., of Creusot, France, were consulted and followed as far as they met the conditions of construction already adopted.

This department, for the production of heavy forgings for guns, armor, shafting, and other purposes, is rapidly approaching completion, and within a year will equal, if not surpass, any other establishment of its kind in the world in its capacity to supply war material, and the perfectness of its means of rapidly producing the heavy forgings required for modern high-power ordnance and the most powerful armored ships yet designed. With a casting capacity for ingots of 100 tons, fluid compression plant, a steam hammer of 125 tons (falling weight), the most powerful hydraulic forging presses ever constructed, and tools of the most approved and advanced type for shaping and finishing, this company has already manufactured and delivered all of the heavy shafting of the cruisers Philadelphia, San Francisco, and Newark, together with forgings for 4-inch, 6-inch, 8-inch, and 10-inch breech-loading rifles, and is now engaged upon the shafting of the armored coast-defense vessel Maine, and 8-inch, 10-inch, and 12-inch breech-loading rifles for both the army and navy, and the armor of the barbette battleship Puritan, the double-turreted monitors Amphitrite, Monadnock, and Terror, the battleship Texas, and the armored cruiser Maine.

In addition to the war material (including hollow and other forgings for shafting, guns, armor, shields, and conning towers), special and miscellaneous forgings, the works have an output of some 250,000 tons of rails, blooms, and billets, and miscellaneous work, under a personnel of about 3000.

The *Chemical and Physical Laboratories* are very complete, and contain Riehle and Emery testing machines of 100,000 and 300,000 pounds capacity.

The company's property at South Bethlehem covers an extent of about 1¼ miles in length by ¼ of a mile in width, of which about 18 acres are under cover.

BETHLEHEM, PA., *October*, 1889.

PLAN

OF PROPERTY OF

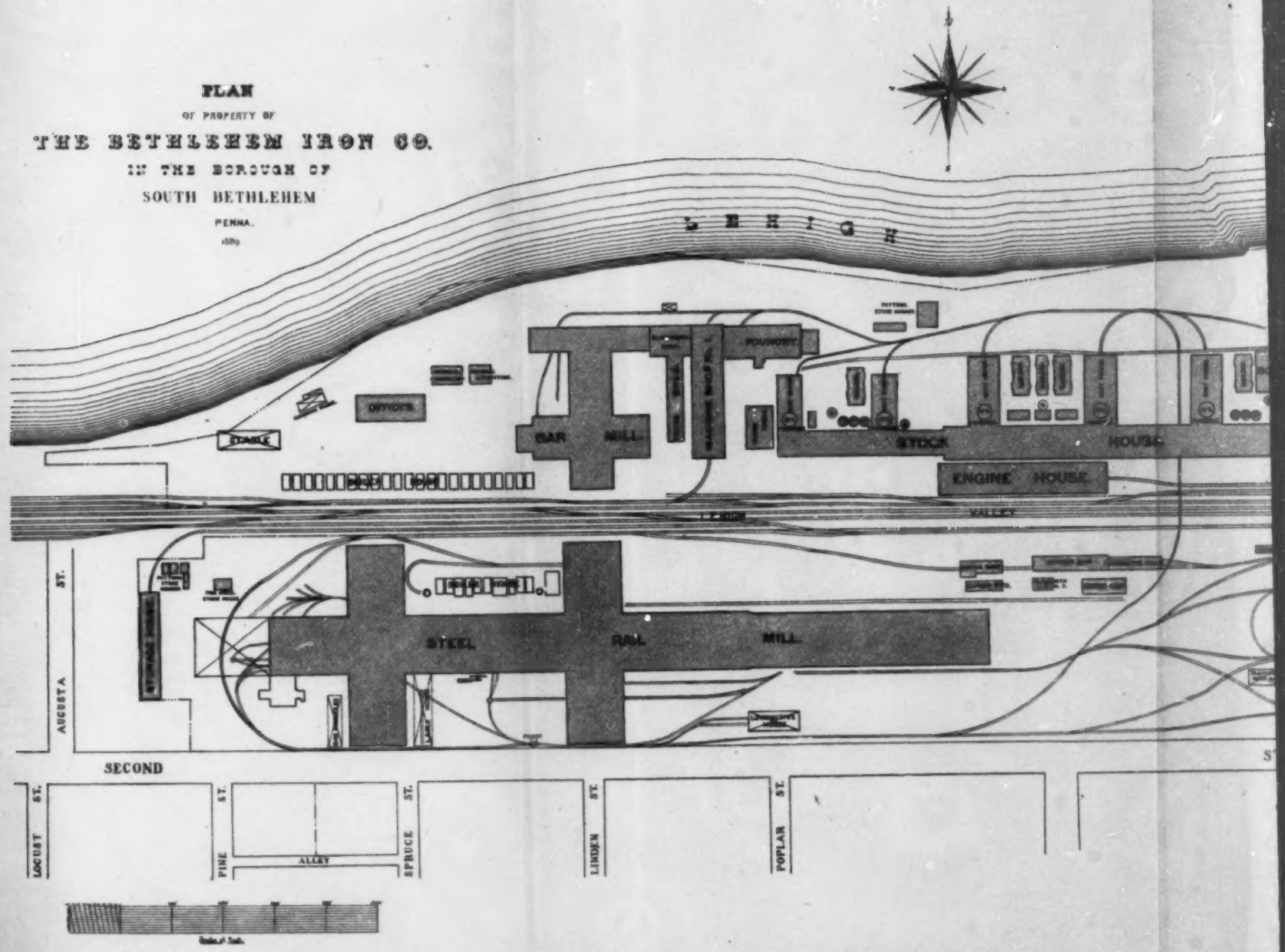
THE BETHLEHEM IRON CO.

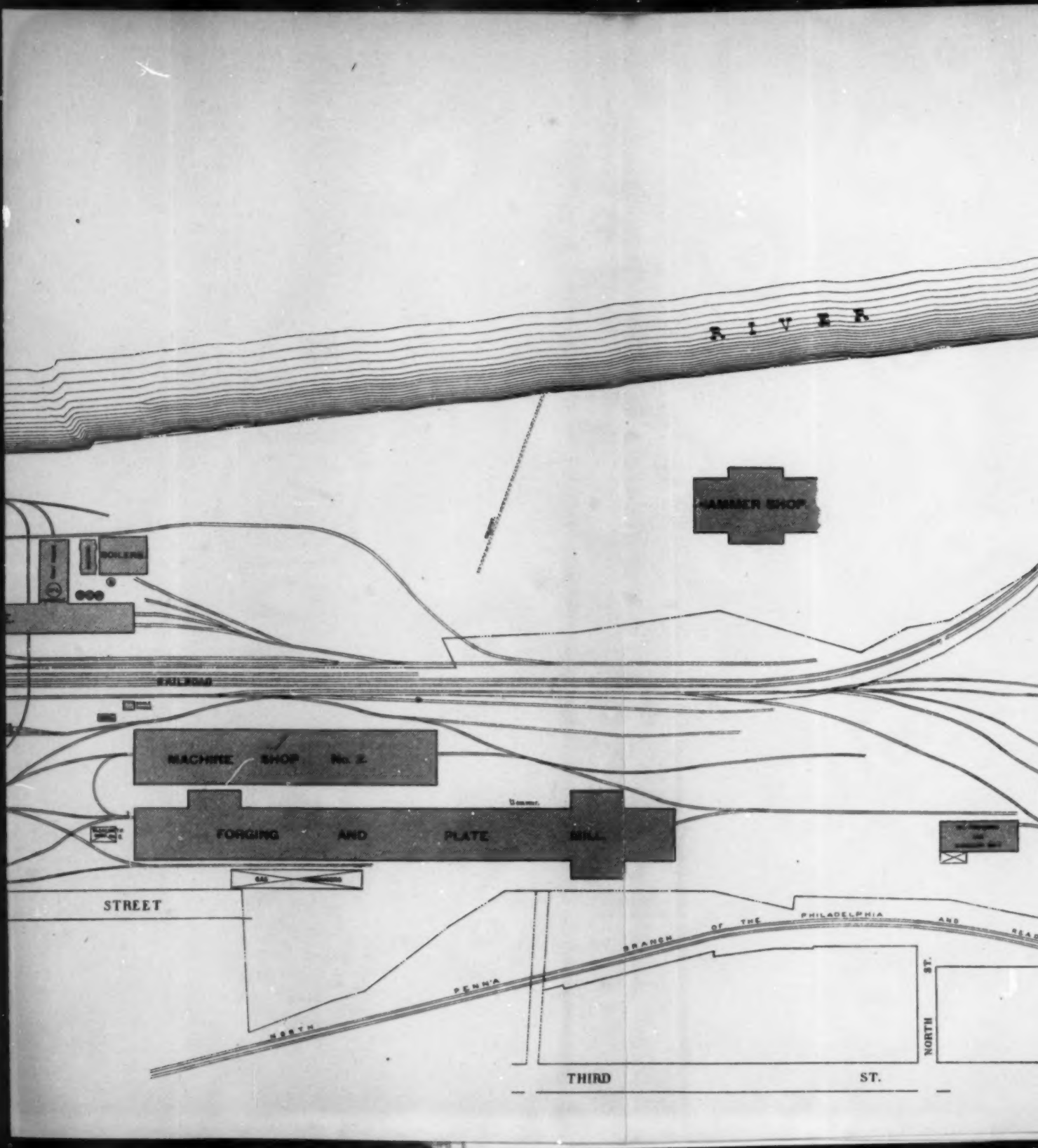
IN THE BOROUGH OF

SOUTH BETHLEHEM

PENNA.

1889

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HAMMER SHOP
BOILERS
RAILROAD
MACHINE SHOP No. 2.
FORGING AND PLATE MILL
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BRANCH OF THE PHILADELPHIA AND
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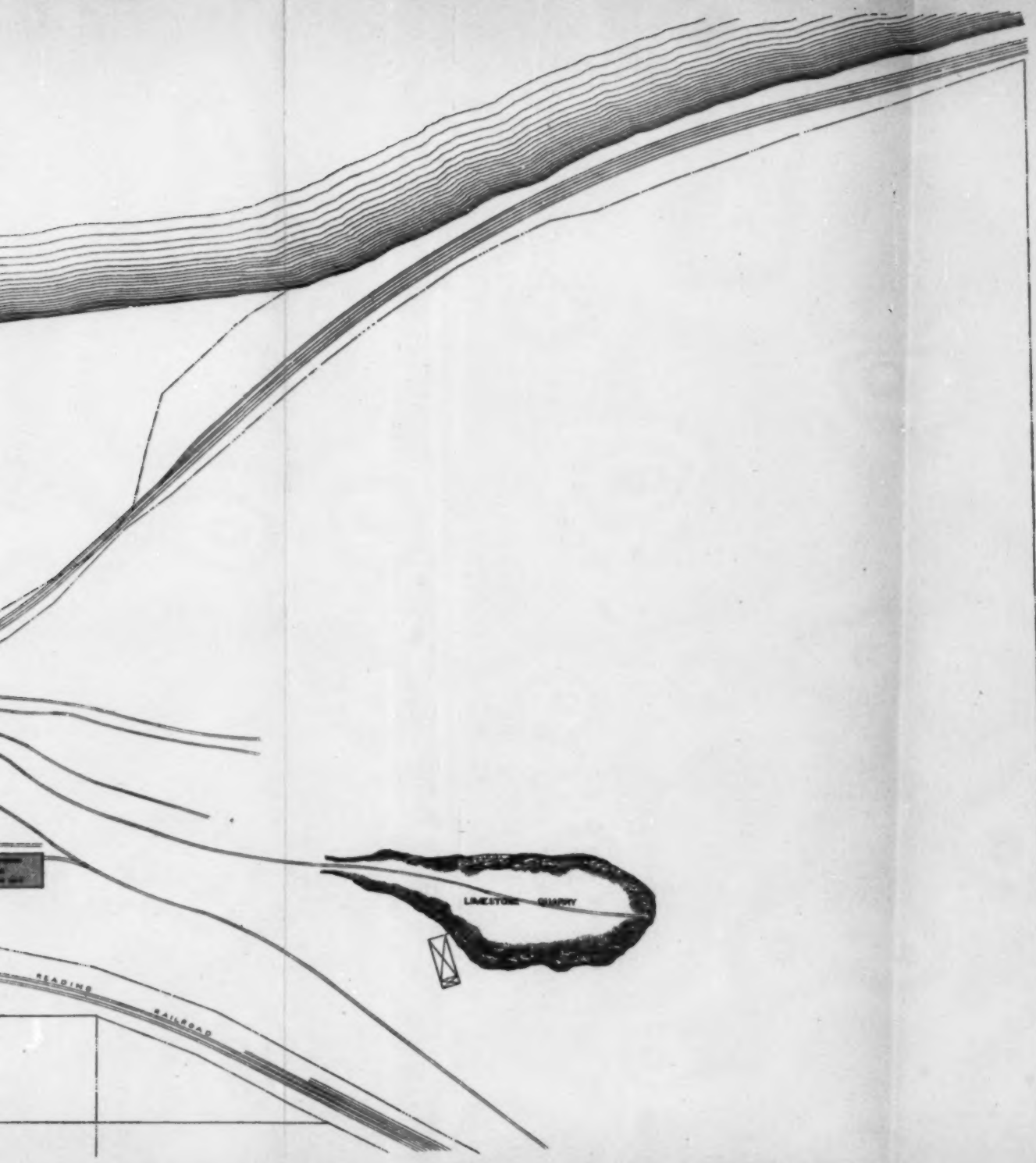
LIMESTONE QUARRY
READING
RAILROAD

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

OUR FUTURE NAVY.

By Rear-Admiral S. B. Luce, U. S. Navy.

[Reprinted from the *North American Review.*]

In his "Essay on History," Lord Macaulay observes that "no past event has any intrinsic importance; the knowledge of it is valuable only as it leads us to form just calculations with respect to the future." Agreeably to that precept, a retrospective survey, so appropriate in this centennial year, will enable us to form just calculations as to what may be reasonably anticipated in respect to the development of our new navy. A necessary condition of the forecast is that no violent political eruptions or international complications shall disturb the course hitherto followed by legislation on naval affairs.

Before proceeding further, let us inquire what constitutes a navy. A navy is, in one sense, a sea army. Or, to speak more correctly, its principal constituent, a fleet, is a sea army, to which all the other component parts are but subsidiary. The French habitually speak of *les armées de terre et de mer.* The analogy between a land army and a sea army is often so close that at some points it merges into identity; and in certain problems of war the two may be reasoned upon as identical. Thus the main body of the land army, composed of infantry, may be compared to a fleet of battle-ships. The infantry of the line acts in masses, and on the field of battle constitutes the principal fighting force. The same is true of a fleet. Well disciplined, a mass of infantry in column or in square is almost impenetrable. Witness the terrible, but fruitless, charges of the French cuirassiers on the solid masses of the English infantry at Waterloo. One of the great lessons of war is that cavalry charges, except against cavalry, are indecisive unless supported by infantry. Says Hamley, in his "Operations of War": "All the formidable inroads of

Napoleon's horsemen on the British line availed nothing, for the want of infantry support." The same principle, precisely, applies to the operations of the sea army. The inroads of cruisers, which are analogous to cavalry, will avail but little unless supported by battle-ships. This position is incontestable. Napoleon regarded the infantry as the arm of battles and the sinews of the army. Infantry, in short, is the first instrument of victory. It finds a powerful support, however, in the cavalry and the artillery.

These tenets are admitted by all military writers, and are universally accepted. Let it now be asked how an army could be organized without infantry of the line. The soldier would probably answer that the question is an absurd one and unworthy of a serious reply. And yet that is just what we are trying to do with our sea army, otherwise known as the navy of the United States. That is to say, we are pretending to build up a navy without the constituents of a line of battle. We are building cruisers of various sizes, which correspond to the cavalry and light artillery of the land army; and we have monitors for coast and harbor defense, which supplement our fortifications; but we have no battle-ships to correspond to the infantry of the line, which constitutes the main strength of the line of battle.

James, one of the best historians of the English navy, remarks that the strength of the navy is the line of battle, rather than its detached or frigate force. "The latter may cruise about," he says, "and interrupt trade, or levy contributions on some comparatively insignificant colonial territory; but it is the former that arrays itself before formidable batteries and strikes dread into the heart of the parent state." Vice-Admiral Penhoat, a distinguished officer of the French navy and an author of note, reaches the same conclusion. "The most powerful agent that can be employed for the defense of the coast," he observes, "is the fleet of line-of-battle ships. That is the active force of all others that is capable of defending any point on the coast that may be threatened by an enemy."

After discussing the necessary qualifications of a battle-ship, he says: "It will be seen, from what has preceded, that the fleet of the line is the foundation of a navy; and that no operation at sea of importance, such as bombardments, the transportation of troops, etc., etc., can be undertaken with security unless the enemy's fleet of the line has first been rendered powerless."

"It is the line of battle, then, which should take precedence in its

development over those accessory forces which, when joined to it, constitute together a navy. The secondary forces, the cruisers, transports, armored coast-guards, etc., should each, according to its importance, have a certain relative proportion to the whole; but they should not impede the development of the principal power."

The policy thus clearly lined out has been advocated by the executive and combated by the legislative branch of the United States Government since the beginning of our existence as a nation, and up to a comparatively recent period; and describes accurately the course followed in England, where everything relating to the navy is done seriously and with a definite purpose. Chief Engineer J. W. King, U. S. N., in his admirable report on "European Ships of War," under the head of "The British Navy," writes:

"It is to the production of the most powerful sea-going fighting ships that the resources of the navy are first directed: ships sufficiently armored to resist the projectiles of any ordinary kind; sufficiently armed to silence forts, or to meet the enemy under any conditions proffered; sufficiently fast to choose the time and place to fight; and sufficiently buoyant to carry coal and stores into any ocean."

This statement finds emphatic confirmation in the recent admiralty programme announced by Lord George Hamilton, the First Lord of the Admiralty. In brief, that programme calls for the building, between April, 1889, and April, 1894, of seventy vessels of war, ten of which are to be battle-ships and sixty cruisers of different types. The report says: "A battle-ship when completed is not entirely efficient unless she has certain small vessels attached to her as scouts; and we consider that out of the seventy vessels, twenty are satellites of the battle-ships. The remaining cruisers will be effective whether used in squadrons or individually. . . . Later on, when an increase is made to our battle-ships, each battle-ship will be accompanied by two smaller vessels; and thus there will be no drain upon our force of independent cruisers."

The strength of the British line is to be brought up in the near future to something over one hundred battle-ships, with cruisers, great and small, in proportion.

Let us now suppose the battle-ship to be subtracted from the floating force of Great Britain. How long could she hold Gibraltar and Malta, control the Suez Canal, and maintain her Indian Empire, by the eastern route? How long could she hold the line from

London to Halifax, Esquimault and India, by the western? How long could she prevent Germany from establishing a military port on the Scheldt? How long could she hold the great strategic points at Jamaica, Barbadoes, and St. Lucie, which dominate the West Indies, the Spanish Main, and the Isthmian Canal, which will eventually open to her a short cut to the Pacific? Without battle-ships the whole British Empire would crumble to pieces, "and, like the baseless fabric of a vision, . . . leave not a rack behind."

In the absence of anything and everything that might resemble a naval policy, we have reversed the usual order of naval development. The battle-ship being the very foundation of a navy, and the United States having no battle-ship, it is plain that in a military sense—the only sense in which a navy can be discussed—she has no navy. Not only that, but she has no foundation whereon to build one. She has the accessories only—the satellites, the cruisers, and the coast-guard ships. The great central body about which the satellites revolve—the solid masses of the line, which give the cruisers moral and material support—are altogether wanting. In military parlance, we have a few light infantry (cruisers) for scouts, and cavalry (cruisers) for reconnoitering; but, in case of repulse, there is no main body of the line to fall back upon. One of the functions of light infantry is to protect the flanks of the army. Our cruisers are to protect the flanks of—what? Nothing! There is no main body, no line of battle, no battle-ship, no navy—nothing, in short, but accessories.

Let us test the truth of this. International complications arise of such a character that the government finds it necessary to send a number of our best ships to a distant point—Samoa, for example. On reaching the place designated, the American admiral, in the Baltimore, as flag-ship, and accompanied by the Newark, Philadelphia, and San Francisco, all splendid 4000-ton ships of the most approved types, finds himself confronted by four battle-ships to dispute his way. The vital parts of the foreign ships and the crews are well protected by heavy masses of steel; while the sides of the Baltimore and her consorts, though of steel, are but little thicker than a single number of *The North American Review*, or, to be exact, five-eighths of an inch thick—sides of no greater powers of resistance than the frigate Constitution, launched in 1797, possessed. Do the people of this country expect their admiral to risk a battle under such circumstances? Hardly, for those ships were designed

expressly to run away from battle-ships, as will presently be shown. That is the fundamental idea which is guiding the development of the new navy: to run away.

It may be observed here that the word fleet is sometimes used to express the entire floating force of the navy. This use of the word is common both in England and in France. In a more limited and technical sense, a fleet is an assembly of twelve or more battle-ships. Used in this latter sense, Great Britain will soon be able to put afloat seven or eight fleets, each fleet filled up to its tactical complement of twelve battle-ships; each battle-ship accompanied by two satellites, with cruisers, torpedo depot-ships, and hospital-ships: while cruisers, acting independently, will be left to protect her own commerce and annihilate that of an enemy. If the military necessities of England compel her to maintain, say, six fleets and their accessories, and the great powers of Europe keep afloat proportional numbers, is it not to the interest of the people of this country to have a floating force of something more than mere accessories? Is it not to the interest of our people to have a navy in reality, instead of the semblance of one? Is it not to our interest to have at least one fleet of twelve battle-ships? That is the question the Executive has been presenting to Congress for the past one hundred years.

With all her enormous iron shipbuilding facilities, England allows from three and a half to four years to build a battle-ship. In this country it would probably take a little longer. The keel of the Chicago, which is not a battle-ship, was laid in 1883, and she is not yet ready for sea; and this at a time when the government is much pressed for ships. Should either of the battle-ships Maine or Texas ever be launched, her time on the stocks will probably cover a period of from seven to eight years. Making the most liberal allowance for increase of skilled labor in iron shipbuilding, it would be twenty years at least before the United States could get a fleet of battle-ships to sea, and in these days wars are reckoned by months. If the American people contemplate building up a navy, it is not a day too soon to formulate some definite plan of development beyond mere accessories.

If there is any one fact made clear by the history of the past, it is the true function of our navy. The rôle of a navy is essentially offensive, as contrasted with seacoast fortifications, which are defensive. This broad distinction must be borne in mind, if the persistent but unavailing efforts of our highest naval authorities, in time past, to organize a navy, are to be understood.

"The proper duty of our navy," it was declared long since, "is not coast or river defense; it has a more glorious sphere—that of the offensive. Confident that this is the true policy as regards the employment of the navy proper, we doubt not that it will in the future be acted on as it has been in the past; and that the results, as regards both honor and advantage, will be expanded commensurately with its enlargement. . . . In order, however, that the navy may always assume and maintain that active and energetic deportment, in offensive operations, which is at the same time so consistent with its functions and so consonant with its spirit, we have shown that it must not be occupied with mere coast defense."

The great principles on which our entire system of seacoast defense has been erected have been laid down with mature deliberation by our highest military and naval authorities. "The means of defense," say they, "for the seaboard of the United States, constituting a system, may be classed as follows: First, a navy; second, fortifications; third, interior communications by land and water; and fourth, a regular army and well organized militia."*

The term navy is defined as "that portion only of our military marine which is capable of moving in safety upon the ocean and transporting itself speedily to distant points." This can be done only by battle-ships equal, if not superior, in fighting power to the average battle-ship of a possible enemy. "Floating batteries," etc., were regarded as pertaining to land defenses, and were deemed "powerful auxiliaries." "The navy," it was said, "being the only species of offensive force compatible with our institutions, it will be prepared to act the great part which its early achievements have promised and to which its high destiny will lead."

Benjamin Stoddert, our first Secretary of the Navy, thoroughly understood the office of a navy. In a communication to the House of Representatives under date of December 29, 1798, after advancing the most cogent reasons, he recommended the building of twelve battle-ships and as many frigates. "Had we possessed this force a

* It may not be out of place here to explain that in classing the navy, which is the arm of offense, among the elements of defense, the words are to be taken in their military sense. Thus we have many instances in history of "defensive-offensive" campaigns, where the defense takes the initiative. The true war of defense, military writers affirm, seeks every occasion to meet the enemy. The French defend themselves by attacking.

few years ago," he adds, "we should not have lost, by depredations on our trade, four times the sum necessary to have created and maintained it during the whole time the war has existed in Europe." In a subsequent report, January 12, 1801, the secretary enunciates a sound principle. He says, in effect: Let our enterprising privateersmen prey on the enemy's commerce. The government should "attend principally to a provision for battle-ships and frigates." The two reports are noteworthy as clearly indicating the true lines of naval development, by the building, first of all, of battle-ships, and showing that the preying upon an enemy's commerce was altogether secondary and not the first objective of the navy.

It cannot be said that Congress responded with alacrity to these earnest appeals. We were paying tribute at the time to the Barbary powers. French cruisers were depredating our commerce, and English vessels of war were impressing seamen out of our merchant vessels; but the navy which could, and eventually did, put a stop to these indignities, found little favor with our national legislature. The Naval Committee, reporting to the House, December 17, 1811, said: "The important engine of national strength and national security, which is formed by a naval force, has hitherto, in the opinion of the committee, been treated with a neglect highly impolitic, or supported by a spirit so languid as, while it has preserved the existence of the establishment, has had the effect of loading it with the imputations of wasteful expense and comparative inefficiency."

We were on the verge of war with England when this "languid spirit" in regard to naval affairs prevailed in the House of Representatives. In 1799 Congress had authorized the building of six battle-ships; but, the amount appropriated being insufficient, no steps had been taken towards setting them up, beyond the purchase of some ship timber, so that a few frigates and sloops-of-war were all we had of a navy.

On the 19th of June, 1812, war was proclaimed against England. Elated by the success which attended our little navy in its first encounter with the English at sea, Congress, now that the war was actually begun, authorized the President, "as soon as the materials could be procured," to cause to be built, equipped, and employed, four battle-ships and six frigates. "This was the first step," says Cooper, the historian of the navy, "that was ever actually put in execution towards establishing a marine that might prove of material moment in influencing the results of a war." But—and this is one

of the impressive lessons of history—although hostilities lasted two and a half years, the first battle-ship to be launched, the Independence, was too late to take part in the war. The successes attending the war of 1812, and the placing the Navy Department upon a better footing by giving the Secretary of the Navy a staff of experienced officers—the Navy Commissioners—to assist him in his duties, excited a passing interest in naval affairs. This was not a little enhanced by the brief war of 1815 with the Barbary powers. Under the impulse of this feeling, Congress authorized the augmentation of the navy to twelve battle-ships. Owing to the limited amount of the annual appropriations, and the small number of seamen allowed by law, but four of them were kept in active service. Three were, during many years, laid up "in ordinary," and five held in reserve on the stocks in such an advanced stage of completion that, on the first sign of approaching hostilities, they could have been launched and equipped for sea in a comparatively short space of time. Built of well seasoned live-oak, they could almost be said to defy the ravages of time. They were broken up, or diverted to other purposes than originally intended, only when the type of battle-ship they represented had become obsolete. They were, with but two exceptions, the very best specimens of naval architecture of the period, and distinctively American in weight of batteries, great strength, capacity, sea-going qualities—everything, in short, that constituted a high order of excellence in a battle-ship of their day.

A flag-ship, it may be remarked, is a fair exponent of the strength of a navy. In the noontide of our naval power, the flag (or broad pennant) of the commander-in-chief was flown by a battle-ship. To-day it is displayed either from a second-rate, that has already reached the limits of usefulness, or from a third-rate but little better off. These are soon to be replaced by a class of flag-ships whose character shall be portrayed later on.

In 1823 President Monroe announced the doctrine which has since taken his name. It embraced two interdependent parts—one political, one military. The former only is now remembered. The formal declaration that the American continents "are not to be considered as subject to colonization by any European power" carried with it an obligation to maintain the means by which that policy could be enforced. Hence the President's admirable letter of January 30, 1824, to the United States House of Representatives against an undue reduction of the navy. The message was accompanied by

a letter from the Secretary of the Navy, in which the naval policy of the government was plainly stated.

"When the vessels now authorized by law to be built," he writes, "are completed, there will be twelve battle-ships . . . The vessels having been built, we must train officers to command and manage them . . . A great portion of the science of the naval commanders can be acquired only on the ocean and by years of labor and discipline."

Accompanying these letters was the draft of a bill for a naval peace establishment; but it found little favor in Congress, and nothing was done.

In 1836 we had reached the meridian of our naval power. On the 18th of February of that year the Senate passed a series of resolutions, one of which ran as follows: That the President be requested to cause the Senate to be informed of "the probable amount that would be necessary to place the naval defense of the United States upon the footing of strength and respectability which is due to the security and to the welfare of the Union."

The Executive replied that "the force to be prepared ready for use when circumstances may require it should consist of fifteen battle-ships, twenty-five frigates, twenty-five sloops-of-war, twenty-five steamers, and twenty-five small vessels, and that the frames, ordnance, etc., should be prepared for ten battle-ships and ten frigates." It was proposed, further, that six battle-ships, eleven frigates, fifteen sloops-of-war, and a number of smaller vessels should be kept in active service during peace, "for the protection of our commercial interests, and to prepare officers and others for the efficient management of the force proposed for a state of war." The year 1850 was fixed upon as the most remote period at which the proposed force ought to be ready. The board was of the opinion, however, that it might be prepared much sooner, "should Congress deem it advisable to make larger appropriations than those suggested." But Congress did not "deem it advisable"; indeed, did not deem it advisable to make any increase whatever. Six years after making their report, the able staff of the Secretary of the Navy—the Navy Commissioners—were legislated out of existence, and the year 1850 passed, and 1860, 1870 and 1880, and now we find ourselves approaching the year 1890, and instead of a "gradual increase," there has been a gradual degeneration of the navy, and we have not to-day a single battle-ship to succeed those launched in 1818–20.

The decline of our naval power cannot be attributed to a radically defective form of naval administration alone, though that is responsible for much of the evil. There is another cause. According to natural laws, the military and mercantile marine of a state rise and fall together. The exception to this law is when a purely military policy compels the maintenance of a war marine; and we are not a people to exercise military prevision.

In the early days of the world's history war-vessels were needed to keep down piracy and enable traders to pursue their way in peace. An extensive commerce begot distant colonies, and both required the constant protection of a war marine. Then a navy came to be an exponent of a nation's wealth and power. The commerce and navy of Tyre grew together, and together fell. Carthage in her days of prosperity monopolized the trade of the Mediterranean, and her navy for a time defied the whole power of Rome. During the middle ages, the Italian Republics, Venice and Genoa, had large interests in commerce and powerful navies. With the loss of the one the other passed away. Spain, Portugal, and Holland, each in its turn, went through the same experience. England presents the greatest example in history of enormous wealth acquired through foreign trade. Colonial possessions followed, and a navy which defies the united forces of any two maritime countries in the world was the natural result.

For a time the United States followed England in her extension of ocean commerce. The American flag became a familiar sight on every sea, and the tonnage engaged in our foreign trade ran up to be second only to that of England. But our foreign shipping had already begun to decline before the breaking out of the rebellion in 1861. Our people were, and are, content to have their carrying trade borne in foreign bottoms, and to see what was once a source of national pride and strength and power, transferred to foreign flags to help make their countries rich and strong. Having sacrificed a large measure of our shipping interests, and with no outlying possessions to protect, what more natural than that there should be a decline of our naval power? Blind or indifferent to the military aspect of the question, the resultant of the several causes has forced the navy to abandon its principal and time-honored rôle as the offensive arm of the government, thrown it back upon the lines of defense, and gradually withdrawn it from the sea. The tendency of the entire navy now is to get on shore and stay there.

The "new navy" took its rise in 1881. The very term is sugges-

tive. It is peculiar to this country, and indicates our methods of procedure in all matters connected with naval affairs. In the maritime countries of Europe naval architecture kept pace with the changes that have been going on for years past in naval and military science. Marine architects and their artisans moved with the times; and the naval officers and seamen had no difficulty in adapting themselves to the continuous, but gradual, changes. These changes were brought about by such slow degrees that there was no precise date to mark the decease of an obsolete type of ship and the birth of a new. It was not so in the United States. On the close of the war of the rebellion we sat down to rest. What mattered it though we had given the Monitor to the nautical world, and a fresh impetus to marine architecture? We ourselves sat down to rest. The building of vessels of war, in which we had once led the navies of the old world, became to us a lost art; and a quarter of a century after the Monitor had effected a revolution in the art of naval warfare, we find ourselves compelled to go abroad for the models of our war-ships; meanwhile having our naval constructors educated in foreign schools of naval architecture. The building of the battle-ship Texas from English designs marks a distinct era in the history of the United States Navy.

For twenty years from the war of the rebellion the Executive had been urging the augmentation of the navy with monotonous iteration; but the people, or their representatives in Congress assembled, would not have it. What wonder we should drop from the list of sea powers? The first Advisory Board was instructed to "recommend such vessels as Congress would be likely to approve"—not what, in the judgment of the Executive, the country ought to have, but what it could get. This was the lesson of generations of experience in naval administration. The board reported, therefore, that as the limit of money Congress would be willing to appropriate for the navy was, without doubt, a very restricted one, the construction of ironclads (battle-ships) was not recommended, though "such vessels are absolutely needed for the defenses of the country in time of war; and if Congress be willing . . ." But, as in 1836, Congress was not willing. Hence the plan for the new navy was not for a navy at all, but for a sort of *pis aller*.

The new steel cruiser upon which we pride ourselves—and justly so—is designed, as already stated, with a special view to run away from battle-ships. She must be able to escape from ironclads, and outrun, so as to capture, merchantmen. "If slower than ironclads,

she could not keep the sea; and if slower than merchantmen, she might as well remain in port." (Report of the Secretary of the Navy, December 1, 1888.) This is all very well, but fifty years ago we could have sent to sea a squadron of ten battle-ships that would have compared favorably with those of any nation on the globe, and to-day we have none.

It is true we have the keels of two battle-ships on the stocks, and they may be finished and even sent to sea before the types they represent become obsolete. Even that addition to the navy would avail but little unless they are the forerunners of others. In 1836 the official programme called for fifteen battle-ships. To-day we need twenty at least. When we shall have put one-half that number afloat we may begin to talk about "rehabilitating" our navy without provoking a smile of derision.

But the people, or their representatives in Congress, are not willing to rehabilitate in that sense. Hence the United States Navy of the future is to be made up of coast-defense vessels, which, according to our custom, will be laid up "in ordinary," and thin-sided steel cruisers for the high seas. Consequently the American flag is to be displayed upon the ocean only by vessels designed to prey upon private property, and this notwithstanding our own proposition to amend the rules of international law by exempting private property at sea from capture.

During the Franco-German war in 1871 it was the French battle-ship that dominated the North Sea. The preying upon the private property of the citizens of either belligerent played a wholly insignificant part in the war. And yet that part, insignificant as it is in a maritime war, is the principal objective of the United States Navy of the future. Thus do we virtually abdicate our position as a sea power.

Kinglake, in his "Invasion of the Crimea," draws, with pardonable pride, a fine picture of the moral effect of the presence of an English man-of-war. It was just before the battle of Alma, when, "as though in arrogant yet quiet assertion of an ascendant beyond dispute, one solitary English ship, watching off the Sebastopol harbor, stood sentry over the enemy's fleet. Men had heard of the dominion of the seas; now they saw it." That "solitary ship" represented the vast, living power of a people ever ready to wield it.

A solitary American steel cruiser, with its delusive prefix of "protected," represents the latent possibilities of a great country placidly awaiting some national disaster to generate its mighty forces.

DISCUSSION.

Ensign BERNADOU.—I have read with care the interesting and valuable paper now under discussion. While realizing the great advantages in the way of increasing national prestige that would speedily result from the creation of a fleet of battle-ships, yet I cannot but believe that a different line of development would be more in keeping with our present interests.

The problem seems to me to be how, with a moderate appropriation continued through a series of years, to build up a navy that will enable us, first, to defend the approaches to important points on our coasts, and to extend the defensive radius at these points until it equals the radius of offense of modern ironclads; second, to assume an offensive up to distances, say of 3500 miles; third, to injure an enemy by crippling his commerce. For these purposes there would be four classes of vessels needed: coast defense vessels in kind and number proportionate to the requirements of the various sections of the coast; torpedo-boats in great number; a moderate fleet of ironclads; protected cruisers, swift and of great coal endurance.

I think that we should develop these vessels as rapidly as possible, bearing in mind our needs in the order of their importance, which I take to be as follows: protection of our coast cities; protection of our commerce; maintenance of our national policy. Let us therefore begin by building coast defense vessels, heavily armed and well protected, light of draught and of good manœuvring powers.

With the ultimate object of protecting our commerce at sea in time of war, let us in time of peace aim directly at increasing the efficiency of our cruising squadrons, and continue to build protected cruisers of high speed and endurance, well armed with numbers of rapid-fire guns.

Finally, to every five of our coast defense vessels, say, let us build one sea-going armorclad, a powerful vessel primarily intended for defensive purposes, but able to act on the offensive when needed. To obtain this latter capability we must lighten draught and therefore increase beam; by so doing we sacrifice speed, but we gain by being freed from the necessity of constructing enormous hulls on speed lines.

I consider that the importance of commerce-destroyers is overrated; for the chief lines of trade of the world, at present, either emanate from our own country, or else skirt the western coasts of Europe, where merchant vessels could easily be protected by any European power; *e. g.*, by convoy from headland to headland. I say this to emphasize my belief that we should go ahead rapidly with the construction of our coast defense vessels, and take a more moderate pace with other types.

As to what our navy shall be at sea in times of peace, I think that we may borrow ideas from the system followed at present in Germany, where, at such times, ironclads are kept at home, partly manned or in ordinary, to be fully manned and exercised at stated times; while lighter vessels are sent abroad. Were battle-ships used by us as flag-ships, we would find, in time of trouble, a large

number of our best vessels—doubtless constituting an important fraction of our offensive forces—scattered over the waters of the globe, and in these days of quick action there would be no time to assemble them.

Let us run for the present the risk that a lack of torpedo-boats would entail, and get them when appropriations for larger craft are not forthcoming.

Captain MAHAN.—I have only to express my entire concurrence in the general tenor of this admirable paper, and in the principles of naval policy adopted in it. Such being the case, having nothing to criticise and little I should care to add, I would have said nothing, were it not that the matter is so important to the country and to the service that it is desirable to re-enforce the paper by as large a consensus of professional opinion as can be obtained.

It is much to be hoped that the whole question of dependence upon swift cruisers and commerce destroying, as a principal mode of warfare, may be more seriously considered than it has been by the navy. If I am right in my opinion, which I understand to be that of Admiral Luce as well, that a war against an enemy's commerce is an utterly insufficient instrument, regarded as the main operation of war, though doubtless valuable as a secondary operation, the United States and its people are committed to an erroneous and disastrous policy. No harm has been done in building the new cruisers, for ships of that kind are wanted; but great harm has been done by the loss of so many years in which have not been built any battle-ships, which are undoubtedly the real strength of a navy.

Lieutenant WAINWRIGHT.—Admiral Luce has clearly struck the keynote of our naval policy, and there must be very few naval officers who do not know that the present necessity for the navy is to create a fighting force, viz., to build battle-ships. The great value of his article is that he so clearly and interestingly exemplifies the point as to impress it upon the general public. All naval officers must be convinced that the real reason for their existence as such is to fight in case of need, aud that while useful and ornamental in time of peace, they will be of little ornament and no use in time of war without battle-ships. The public have heard so much of the fine navy that has been building for some years past that they imagine the United States Navy has considerable fighting power. Admiral Luce's paper is well calculated to disenchant their minds of this fallacious impression. Then it is for the people of the United States to say whether they will properly protect their immense interests, or leave them under the doubtful shelter of a limited number of desperate expedients.

I do not think that it was a mistake to begin by building unarmored cruisers, because at the time the new navy was commenced the want of plant or experience necessary for building vessels of war would have prevented our building armored vessels in anything like reasonable time. It was very sensible to gain the experience on the less complicated ships and to gather the plant slowly. Now we have the plant and the experience, everything necessary but the appropriation. It is to be hoped that the public will recognise that battle-ships are necessary to oppose battle-ships, that until they are provided a large

proportion of the wealth of the country is at the mercy of any maritime power, and, furthermore, that it takes years to build a battle-ship. They must learn that fortifications, mines, floating batteries, and torpedo-boats are auxiliaries to the main defense, that by their means they may protect some points of the coast from actual assault, but not all, and beyond this that by none of these can they prevent blockade. Let this idea strike in and we will have battle-ships. It will only then be necessary to determine the quantity and quality. The quantity may be determined by the force maintained by the strongest probable enemy. He will be able to devote a certain proportion of his battle-ships to attack us. If we have suitable auxiliary defenses such as fortifications, mines, torpedo-boats, and coast defense vessels, our fleet of battle-ships may be smaller than the one he can send against us, for not only can we count upon the aid of the coast defense vessels, but also he will be unable to accomplish anything unless he can mask our fleet. Taking this into consideration, it would seem as if the twelve battle-ships mentioned by Admiral Luce were the smallest number sufficient to give a fair amount of security to our coast.

The type of battle-ships to be selected is a far more difficult problem, and the American battle-ship of the future has yet to be designed. With a small number of battle-ships, all of them must be able to enter our principal ports, and this puts a limit on their size. They must have the necessary battery, protection, speed and endurance. As their main sphere of usefulness will be near our own coast, they might have less coal endurance and a smaller supply of ammunition than foreign battle-ships of the same size, and this saving of weight could be used to increase the weight of battery or armor, that is, in coal endurance they would have a little less than ordinary battle-ships and more than coast defense vessels.

Whatever the type selected may be, we must have battle-ships, and we may rely upon it we have talent enough in the navy to design the best that can be built within the necessary limitations, if the task be assigned and the money be forthcoming.

Commander HARRINGTON.—Great Britain possesses 71 armored vessels, of an aggregate displacement of 509,000 tons and cost of 131 millions of dollars. Of these, 27 ships, of a total displacement of 224,000 tons, have been built since the year 1880 at a cost of 70 millions of dollars. About 50 per cent of the naval force in armored vessels is of more recent design and construction. Nevertheless, 8 armored battle-ships of 14,150 tons each and 2 of 9000 tons each, an aggregate of 131,000 tons, are building and to be completed by April, 1894, at an estimated cost of 42 millions of dollars.

The unarmored cruising navy of Great Britain is composed of 182 vessels, of an aggregate displacement of 316,000 tons, and cost of 71 millions of dollars. Of these, 118 vessels of 204,000 tons have been built since 1880 at a cost of 47 millions of dollars. (The protected cruisers are included.) About 64 per cent of the unarmored and protected cruising navy is of more recent design and construction. Nevertheless, 60 cruisers, of 188,000 tons displacement, and estimated cost of 43 millions of dollars, are to be added to the navy by April, 1894.

The torpedo-boats owned by Great Britain number 147, costing nearly seven millions of dollars.

All the figures relating to cost of this navy are exclusive of the cost of armament.

Assuming that the power of armament is proportional to the displacement of the vessels carrying it, we find that about 60 per cent of the cruising naval force of Great Britain is placed in armored ships.

The vast sums of money which the people of Great Britain willingly spend upon their navy is the insurance of a mighty sea trade and the cost of maritime empire. No other country has such interests upon the sea, and none has emulated Great Britain's naval expenditures. Naval force is maintained by each nation with a primary regard to its necessities, defensive or otherwise, however limited by difficulties of finance. The number of torpedo-boats relates to the number of ports and the extent and navigability of coast. Fast cruisers are necessary to any country which, like Great Britain, has numerous ocean lines of commerce to convoy and protect; and they are desirable for any country to raid the commercial routes of a possible foe. The number of armored battle-ships is determined not only by the demands of coast defense, but by the existence of colonies, by obligations of protection or defense voluntarily conferred upon distant countries or people, by international relations in general and the part and influence it is intended to exert upon the sea and in the affairs of the world.

The necessities of foreign countries, as illustrated by their naval constructions, do not present a measure of the amount of naval force required by the United States; but in regard to kind and quality, foreign navies offer most useful suggestions to a country just entering upon naval construction. The composition of a naval force should have a direct relation to the kinds of weapons employed by people who may become enemies. Gunboats are not built to oppose cruisers, nor cruisers to engage armored vessels. It will happen that vessels of different classes or types will meet on unequal terms. An instance has occurred in which several cruisers designed the capture or sinking of an armored ship, chiefly by ramming. Victory has often declared for the weaker antagonist using superior gunnery, strategy, or tactics, or has turned upon some fortuitous circumstance of battle. For such reasons and with such hopes, men will take the risk of odds in number and kind of weapons. But these conflicts are infrequent and arise under exceptional circumstances. As in the past, the cruiser or frigate which comes in the future under the guns of a battle-ship will be captured or destroyed. Modern cruisers are built with greater speed than armored vessels, upon the distinct idea and expectation that they will not usually pass under the guns of a battle-ship. In other words, they will run from an armored vessel, except under circumstances which will justify exposure to its battery. Ships armed for combat seek their own types of antagonists, but avoid their superiors. Undue neglect of the higher types is a fault of naval policy which confirms a naval inferiority.

Great Britain's need of fast cruisers rises with the extent of her ocean traffic. These vessels must have great coal endurance, and, as their speed must be maintained in heavy seas, they must have great length and draft.

Accordingly, there is a marked increase in the displacement of the later cruisers. The average displacement of the vessels of the existing unarmored navy of Great Britain is about 1740 tons, while that of the additional sixty cruisers building is 3138 tons. Forty-two of the latter average 4168 tons, the remaining eighteen being torpedo gunboats of 735 tons. The number of cruisers is controlled by the conditions of Great Britain's commerce; but for that vast interest, the armored battle-ship of less speed would be preferred for war service. This reasonable desire for armor, in a vessel which may have to do heavy fighting in convoy duties, has brought into existence the armored cruiser, which embodies in a modified degree the heavy battery and armor of the battle-ship together with the high speed of the vessel known as the protected cruiser. The convoy of fast steamers will be the most important office of the armored cruiser, although a weapon but little inferior to the battle-ship.

The United States has no existing interest of ocean trade, comparable with those of Great Britain and other countries, demanding the creation of a large number of unarmored or merely protected cruisers. Upon a declaration of war sailing vessels will be laid in port. Merchants will not be able to place them under a neutral flag, since such a transfer subsequent to a declaration of war will not be respected. Much of the coastwise trade will pass to the railroads and internal traffic routes. Commerce, externally, must be carried on by fast steamers. The cruisers, then, will engage in their contemplated duties, as despatch vessels, as lookouts along the coast and to the fleet of battle-ships, in convoying, and in preying upon the commerce of the enemy. The vast enlargement of internal industries and traffic in our extensive country has absorbed the energies and capital of our people. Under new conditions of money and labor, when both seek new enterprises, whenever external commerce shall offer fair profit, the United States will acquire fast merchant steamers. Capital will then seek foreign trade in proportion to the existence of means of protection, the visible assurance in every part of the world that the country is resolved to defend the property of its citizens upon the sea as well as upon the land. It is the confident hope of the establishment of an American sea trade, carried under the flag of the United States, which justifies the construction of numerous cruisers for our navy.

Cruisers cannot prevent the descent of a hostile naval force upon a coast. The approach of such a force could be reported by cruisers, giving warning by signal and telegraph to all threatened points; but it is only a line of battle-ships which can stop a hostile fleet or control its selection of a point of attack. The enemy cannot raid the coast or attempt to lay a city under contribution while subject to an attack in rear. He must seek and defeat the fleet defending the coast before venturing upon any territorial operation. The defending fleet limits the movements of the enemy from the moment the former gets touch through its cruisers with the latter, and the defense may even choose the time and place of action. When there is no fleet the local defenses must be numerous and extensive, and there are many localities upon a coast which cannot be defended, either wholly or in part, by fixed batteries. When there is no defending fleet the enemy may often do pretty much as he pleases, and can always secure harbors for the use of his force in the vicinity of intended

operations. The French ruled the seacoast of China in 1884–85 because the Chinese could not oppose to them a line of battle separated from the local defenses. The dominant fleet defending the Chesapeake in September, 1781, secured results momentous to this country. The non-existence of a fleet of defense in 1814 gave Washington into the hands of the enemy.

Rams and sea-going battle-ships can preserve control of the coast waters and give immunity to the coast from naval attack and bombardment. An armored fleet is otherwise necessary to the dignity and honor of the country. The United States has incurred obligations abroad which have been and can be discharged, without a fleet, only during the non-interference of foreign powers. A principle of rule upon the American continent rests upon the *latent* power of a great country, a precarious support which may be affected by the interests or ambitions of other great nations. Not many years ago an impending war with a foreign country found the United States without proper means of coast defense, and without weapons to compel a compliance with its demands.* Had war ensued, our country, doubtless, would have been victorious at last, but, perhaps, after losses and humiliations. The construction of an inter-oceanic canal, owned by citizens of the United States, and the establishment of a trade under our flag, will increase the number of those occasions upon which the country should show its readiness and ability for immediate defense of its rights abroad as at home. The means must be proportioned to the ends desired: cruisers, torpedo-boats, and torpedo gunboats will not suffice.

The recent development of the quick-firing gun and high explosives has given a new value to armor. In addition to protection of a ship's machinery and buoyancy by protective decks and water-line armor and cellulose belts of suitable thickness, a moderate thickness of armor must be placed about the batteries to prevent the explosion of detonating shell among the crew, and so insure the uninterrupted service of the guns.

In the Baltimore and our newest cruisers, the protective decks are of such thickness and position as insure the floating of the ship under a heavy pounding of projectiles. This measure of safety to buoyancy and machinery is independent of the uncertain coal protection, which may or may not exist at the time of action. The special danger of these vessels is the slaughter of the crew by quick-firing gun projectiles, within the distance at which the fire of that gun may be corrected successively. In a word, they are not close-action ships, though they may rightly engage at any distance vessels of their own type and similar armament. Their tactical distance for action is determined by the primary battery, but modified by the absence of adequate protection against the shorter range quick-firing gun. It is of such vessels that the London *Army and Navy Gazette*, reviewing the United States Navy, recently used the following language: "It will be seen that the United States are in earnest in the intention of resuming their position as a naval power. It is, however, somewhat significant that at present all this construction seems to tend in the direction of vessels more fitted to run away from an antagonist of real weight, than to sustain the glorious traditions of the American sea service.

*Officers of the navy will remember how hospitably we received, at this time, in one of our navy yards, an ironclad belonging to the country referred to.

With but one or two exceptions these ships are better prepared to destroy commerce than to protect it. There is no sign of a fleet fitted to cope with European armorclads if they crossed the Atlantic, as they have done before. After all, though, it is better to crawl before trying to run, and we may yet see designed, laid down and built by native talent, in a United States navy yard, that crux of naval construction, the 'battle-ship of the future.'"

The designs of the British armored ships Nile and Trafalgar and the Italian Re Umberto have been changed in order to provide protection against detonating shell. The British Admiralty, in possession of the results of experiments with detonating shell and quick-firing gun projectiles, gave four inches of armor about the auxiliary armament of the new battle-ships, and, subsequently, available displacement in the designs was utilized by increasing slightly that part of the armor. Armored ships building for Chili, Greece, and Russia have a similar feature.

In the Dupuy de Lôme and other side-protected cruisers of the French navy, the battery armor is four inches of steel. The water-line armor is reinforced by a coffer-dam filled with obturating material. The new British cruisers of the first class are to have similar protection to their batteries, notwithstanding an increase in the protective deck to a maximum thickness of five inches. It is but a step in the further development of such vessels to the armored cruiser and the battle-ship.

As we have seen, the marked drift in construction of cruisers is armor for batteries and external protection, as well as internal armor to preserve the buoyancy and stability; and we must inevitably follow that tendency. The powerful battery of the Baltimore is not installed merely to harry commerce. She will fight her own kind at least. Our next first-class cruisers should meet the improved types, with which the Baltimore may not be matched on equal terms. The evolution passes to the armored cruiser, and towards that conclusion Spain, Russia, and other nations, as well as England, have turned a considerable part of their naval constructions.

In each type of war vessels our ships should equal the best afloat under foreign flags; and since the total naval force will be inferior in number to those of many nations, the navy should be composed chiefly of ships of the higher types. The Petrel and the Dolphin are very useful and economical war vessels for a time of peace, but the reason of their existence for a state of war is not apparent. Every ship should have a distinct office in war, and her construction should be determined with reference to that office. If the duty assigned is to oppose a war vessel at sea, armor is a part of construction which, at the present day, cannot be neglected.

If two battle-ships and a suitable number of auxiliary vessels are laid down annually, a quarter of a century will elapse before the naval force will be commensurate with the need of the country. A dozen armored vessels should be built as soon as the material can be obtained. While these are building, with an annual programme of additional construction duly arranged, the manning of the completed force will require some attention and legislation. But each measure, providing ships or men, should make perfect some part of a definite and lasting naval policy.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

STEAM TRIALS OF THE ROYAL ITALIAN IRONCLAD LEPANTO.

By Major Nabor Soliani, Royal Italian Navy; Member.

Read at the Thirtieth Session of the Institution of Naval Architects, July 26, 1888; the Right Hon. Earl of Ravensworth, President, in the Chair.

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The R. Italian ironclad Lepanto underwent recently a series of trials at sea which are interesting, both in themselves and with reference to the size and type of the ship and the power and type of her engines and boilers. It is, in fact, the first time that a power of 16,000 I. H. P. has been developed on board an ironclad, giving her a speed of over 18 knots, and that a large number of locomotive boilers, in connection also with boilers of a different kind, have been worked together with complete success.

I have got permission from His Excellency the Minister of Marine, Mr. B. Brin, the designer of the ship, to put before this institution the results obtained, hoping that their record, enhanced in importance by the considerable amount of attention that this type of ship has attracted from the naval and the engineering world, will be a useful addition to the knowledge already gained on the propulsion of modern war-ships.

A description of the Italia, the sister ship of the Lepanto, was given some time ago in scientific newspapers (*Engineering*, February 17, 1888, p. 158), and therefore I shall restrict myself here to the principal dimensions and data of the Lepanto that have a bearing on the subject.

The principal dimensions of the Lepanto are as follows:

Length between perpendiculars, . .	400 ft. 6 in.
Breadth, ...	72 ft. 9 in.
Depth, moulded, ...	46 ft.
Mean draught, normal, ...	28 ft. 4 in.
Area of midship section, . . .	1843 sq. ft.
Displacement, ...	13,851 tons.

The ship is entirely built of steel, and has no sheathing on her bottom, differing in this respect from the Italia, in which the steel bottom is sheathed with wood and zinc.

The internal divisions are pretty much the same in both ships, with the exception of the boiler-rooms, which are differently arranged on account of the different type of the boilers.

The Italia is fitted with twenty-six boilers of the Admiralty oval marine type, divided into six compartments, three forward the engine-rooms and three aft, each compartment having its own funnel.

On the Lepanto there are also six compartments of boilers, similarly situated, as shown in Fig. 1 (Plate VI), but only the two near the engine-rooms have marine oval boilers, four in each, and the remaining four compartments have locomotive boilers, four in each, making a total number of eight oval marine boilers and sixteen locomotive boilers. Their arrangement is clearly shown on the sketch.

The locomotive boilers, which form, perhaps, the main interesting feature of the machinery, deserve special notice. There are two furnaces in each boiler, separated by a longitudinal water space, which, however, stops short of the tube-plate, leaving a passage between, above the bridge. The furnaces are just as long as the fire-grate, but to prevent the fire damaging the tubes, and to ensure a good combustion of the gases, a high hanging inclined baffle brick bridge is fitted, as usual in railway practice, in each furnace at the end of the fire-grate.

The bottoms of the ash-pits form water-pans to keep the grates cool; the latter are made with longitudinal cast-iron rocking bars.

The oval boilers have three furnaces, each discharging into one common combustion chamber. Their grates have ordinary fire-bars $\frac{3}{4}$ inch thick, with $\frac{5}{8}$ inch interstices. There are four funnels—two for the forward set of boilers, and two for the after one.

In each set the oval and the locomotive boilers have each their own separate funnel.

The boiler-rooms are provided with twenty fans—four in each oval boiler-room, and three in each locomotive-room—capable of maintaining an air pressure over $2\frac{1}{2}$ inches of water in the former, and of 4 inches in the latter.

The main engines, four in number, and arranged in four separate compartments at the center of the ship, are of the well-known type of Messrs. Penn, with three equal vertical cylinders, as applied on

H. M. ships Ajax and Agamemnon, working compound at moderate power, and direct at full power.

The cylinders are steam-jacketed, and fitted with a double ported flat-slide valve, having an expansion valve working on its back, which allows of any degree of cut-off being fairly obtained.

The main engines work their own air and main feed pumps, the circulating pumps only being, as usual, moved by independent engines.

The following are the leading particulars of the engines and boilers.

PARTICULARS OF MACHINERY.

OVAL BOILERS.

Boilers—

Number of boilers	8
Height	14 ft. 7 in.
Width	11 ft. 7 in.
Length	10 ft. 2 in.

Furnaces and Combustion Chambers—

Number of furnaces in one boiler	3
Diameter of furnaces	3 ft. 2 in.
Length of furnaces	7 ft. 4 in.
Width of combustion chamber	10 ft. 2 in.
Depth " "	2 ft. 2 in.
Height " "	6 ft. 6 in.
Capacity of furnaces and combustion chambers in one boiler above fire-grates	240 cubic ft.

Grates—

Length of grates	6 ft. 6 in.
Area of grates in one boiler	59 ft. 8 in.
Arrangement of fire-bars	Longitudinal.
Type of fire-bars	Ordinary.
Material of fire-bars	Iron.
Thickness of fire-bars	¾ in.
Interval between fire-bars	⅝ in.

Tubes—

Number of tubes in one boiler	306
Material	Brass.
Length of tubes between tube plates	7 ft. 3 in.
Diameter of tubes (internal)	2¾ in.
" " " (external)	3 in.
Area through tubes in one boiler	12.6 sq. ft.
Heating surface in one boiler { tubes	1744 sq. ft.
Heating surface in one boiler { total	1920 sq. ft.

Total for all Eight Oval Boilers—

Grate area	478.4 sq. ft.
Heating surface { tubes	13,952 sq. ft.
Heating surface { total	15,360 sq. ft.
Area through tubes	100.8 sq. ft.
Water surface	862 sq. ft.
Capacity of furnaces and combustion chambers above fire-grates	1920 cubic ft.
Capacity of steam chamber	2560 cubic ft.
Weight of water	124 tons.

Funnels—

Number of funnels	2
Size (oval)	5 ft. 6 in. x 7 ft. 4 in.
Height above fire-grate	76 ft.
Area	80.6 sq. ft.

Ratio of—

Cube heating surface ÷ grate area	27 sq. ft.
Total heating surface ÷ grate area	32.1 sq. ft.
Area through tubes ÷ grate area	0.211 sq. ft.
Area of funnels ÷ grate area	0.168 sq. ft.
Water surface ÷ grate area	1.8 sq. ft.
Capacity of steam chamber ÷ grate area	5.35 sq. ft.
Capacity of furnace and combustion chambers ÷ grate area	4 sq. ft.
Load on safety valves	60 lbs.

Fans—

Number of fans	8
Diameter of fans { four	4 ft. 6 in.
Diameter of fans { four	6 ft.
Type of engines	Brotherhood.

LOCOMOTIVE BOILERS.

Boilers—

Number of boilers	16
Height of boilers	9 ft. 6 in.
Width of boilers in front	7 ft. 11 in.
Length of boilers	14 ft. 5 in.
Diameter of barrel	6 ft. 7 in.

Furnaces—

Number of furnaces in one boiler	2
Width of furnaces	3 ft. 3 in.
Length of furnaces	6 ft. 8 in.
Height of crown above fire-grate	6 ft.
Capacity of furnaces in one boiler	260 cubic ft.

Grates—

Length of grates	6 ft. 6 in.
Grate area in one boiler	42.2 sq. ft.
Arrangement of fire-bars	Longitudinal rocking.
Material	Cast iron.
Type	Having side inclined combed air grooves.

Tubes—

Number of tubes in one boiler		376
Material		Brass.
Length of tubes between tube plates		7 ft. 7 in.
Diameter of tubes	internal	1¾ in.
	external	2 in.
Area through tubes in one boiler		6.27 sq. ft.
Heating surface in one boiler	tubes	1490 sq. ft.
	total	1670 sq. ft.

Total for all Sixteen Locomotive Boilers—

Grate area		675.2 sq. ft
Heating surface	tubes	23,840 sq. ft.
	total	26,720 sq. ft.
Area through tubes		100.3 sq. ft.
Water surface		1412 sq. ft.
Capacity of furnaces and combustion chambers above fire-grates		4160 cubic ft.
Capacity of steam chambers		3360 cubic ft.
Weight of water		105.6 tons.

Funnels—

Number of funnels	2
Size (oval)	6 ft. 4 in. x 8 ft. 2 in.
Height above fire-grate	72 ft.
Area	94 sq. ft.

Ratio of—

Cube heating surface ÷ grate area	35.3 sq. ft.
Total heating surface ÷ grate area	39.6 sq. ft.
Area through tubes ÷ grate area	0.15 sq. ft.
Area of funnels ÷ grate area	0.14 sq. ft.
Water surface ÷ grate area	2.09 sq. ft.
Capacity of steam chambers ÷ grate area	4.98 sq. ft.
Capacity of furnaces and combustion chambers ÷ grate area	6.16 sq. ft.
Load on safety valves	60 lbs.

Fans—

Number of fans		12
Diameter of fans	four	4 ft. 6 in.
	eight	6 ft.
Type of engines		Brotherhood.

ENGINES.

Description of engines	Three equal vertical cylinders, Penn's type.
Main engines—	
Number of engines	4
Number of cylinders in one engine	3
Diameter of cylinders	54 in.
Stroke	39 in.
Number of cranks in one engine	3
Angle of cranks	120°
Collective indicated horse-power	18,000
Revolutions	96
Condensers—	
Number of condensers	8
Collective cooling surface	31,300 sq. ft.
Propellers—	
Number of propellers	2
Description	Admiralty.
Diameter	20 ft. 6 in.
Number of blades	3
Pitch	20 ft. 6 in.
Pitch ratio	1
Surface of blades in one propeller	80 sq. ft.

PARTICULARS OF TRIALS.

The trials were to be made in accordance with the following programme, proposed by Messrs. John Penn & Sons, and accepted by the Ministry of Marine:

1. A trial with only two oval boilers at work, and the after engines only at work on the compound system, to ascertain the most economical steaming of the ship.

2. A trial with the eight oval boilers at work, the four engines working compound.

3. Ditto with four engines working direct expansion.

4. A forced draught trial with only the after set of engines and boilers at work, the engines working direct.

5. A forced draught trial with all eight oval boilers and eight locomotive boilers at work, the four engines working direct.

6. A full-power forced draught trial or trials, with all the engines and boilers at work, the engines working direct.

This programme was not completely carried out, on account of the ship having been put in commission, which prevented the final

18,000 I. H. P. trial being made. It went, however, far enough to show what can be expected from the engines when working at their full power.

The trials were made along the eastern coast of the Gulf of Genoa, from Spezia to Genoa and back, the two runs being altogether over eighty nautical miles. A portion of the forward run from Spezia to Genoa was taken in each trial, to bring up the engines to the desired speed.

The speed of the ship was ascertained by means of bearings on well-known points on the shore in both runs.

The bottom of the ship was fairly clean, the ship having been docked on March 1, viz., about one month before the trials.

The ship was fully laden in all the trials, with very slight differences of draught.

The indicated horse-power developed was ascertained from the indicator cards of the main engines, without taking any account of the steam used for auxiliary purposes.

The trials were carried out under the direction of Mr. J. W. Fairley and Mr. May, who represented the firm, and of Mr. Holland, the engineer in charge.

All the results obtained and the conditions of trials are figured on the annexed table, and to them the following remarks will serve as an illustration.

One of these remarks is of great importance, as it refers to the behavior of the locomotive boilers, which was perfect.

After the rather discouraging experience with locomotive boilers working in sets on board some ships, as the Flavio Gioja of the Royal Italian Navy, and the Polyphemus of the Royal English Navy, some fear was entertained that similar troubles might be experienced with the Lepanto, in which the difficulty appeared to be still greater, considering the larger number of boilers to be worked together in so many different separate compartments.

But nothing of the kind happened, nay, everything went to prove the contrary.

From the beginning of the preliminary trials, which took place towards the end of last year, the locomotive boilers gave evidence of their good working, which went on increasing trial after trial, so as to be now an established fact.

They never primed nor gave any trouble whatever. The feeding was occasionally uncertain, but the fault was due to air that collected

in the main feed pipe. This imperfection was removed, and on the last two trials the feeding was quite satisfactory. After each one of the last three forced draught trials the locomotive boilers had tubes leaking, but in small numbers, and not more, comparatively, than the oval boilers, which, even in this respect, did not behave better. Moreover, there were discrepancies between the different compartments of boilers, locomotive as well as oval, which show that the management of the fires has a good deal to do in this matter.

The ventilation of the locomotive stokehold is excellent. The fans being fitted on top of the boilers, no current of air strikes the floor, and a thorough cool ventilation and forced draught are obtained without any inconvenience whatever from coal dust. The same may be said of the oval boiler stokeholds, where the fans are fitted on the wings behind the boilers, but, although the supply of air is ample, the temperature does not during forced draught fall so low, probably on account of the boilers facing each other. The mean temperature of the oval boiler stokeholds was about 106° against 88° in the locomotive boiler stokeholds, while the atmospheric temperature oscillated about 58°.

The engines worked very satisfactorily all through the trials, without the slightest hitch occurring in any part of the whole machinery. This circumstance helped, no doubt to some extent, the good performance of the boilers, which had never to be checked or hampered when in full swing.

The power of 16,150 I. H. P. on the last trial was developed by the engines with a mean air pressure of 1.9 in. of water in the locomotive boiler stokehold, and of 1.6 in. in the oval boiler stokehold, the coal burnt per square foot of grate per hour being 51 pounds in the former and 38 in the latter. But as, at the preliminary partial trials mentioned above, the oval boilers were worked up to 2½ in. of pressure and the locomotive boilers up to 3½ in. with perfect success, burning 45 and 68 pounds of coal respectively per square foot of grate per hour, there is evidently room left for more power. The gain in speed which would follow such increase of power is, however, not very great, as is clearly apparent from the results of the last two trials, and still more from the I. H. P. Curve, shown on Fig. 2 (Plate VII), of which something will be said hereafter.

A very good performance was that obtained on the sixth trial (April 28), when, with only two-thirds of the boilers at work, the engines developed over 12,000 I. H. P. (two-thirds of the total

power), driving the ship at nearly 17 knots. The cut-off being at 0.175 of the stroke, the steam worked with a ratio of expansion 4.35, which, from the consumption of water shown by the indicator cards, appears to give the most efficient performance of the engines at great power.

A circumstance deserving notice is that all these trials were carried out with the ship's stokers, who, for the greater part, were not yet trained for forced draught stoking.

Regarding the efficiency of the engines, although the consumption of coal was the lowest on the first trial, when the two after engines were acting compound at very low power with a great ratio of expansion (about 11), this condition of working does not appear to be the most efficient, as the consumption of water shown by the indicator cards was greater on this trial than on the next, when the ratio of expansion was reduced to 3.5 only.

The same thing happens, although in a less marked degree, when the engines act with direct expansion, as there is no material difference in the consumption of steam over four expansions. Below this ratio the consumption increases, as may be seen from the results of the last two trials.

To have more complete data of the ship and engines' performance, besides the trials above mentioned, runs were made on the measured mile to ascertain the speed of the ship corresponding to the lowest possible speed and power of the engines; also the power and speed of the engines for a speed of about 10 knots of the ship.

The results are as follows:

Speed of ship, ...	knots,	2.7	10
Revolutions, ...		15	55
I. H. P.		158.6	2403

Now I beg to call attention to Fig. 2 (Plate VII), in which the results relating to the ship's performance are graphically recorded, in connection with the E. H. P. Curve, as was determined by experiments on the model of the Italia made for the Royal Italian Government by Mr. R. E. Froude at Torquay, by the kind permission of the Admiralty.

The E. H. P. curve *aa* corresponds to a displacement of 14,784 tons, which is approximately the mean displacement of the Lepanto at the various trials. The Lepanto being a finer ship than the Italia for the same displacement, the ordinates of curve *aa* should be low-

ered a little, but considering that the bottom of the Lepanto was not perfectly clean, curve *aa* may be accepted as sufficiently correct.

bb is the I. H. P. curve.

dd is the "indicated thrust curve," as it results from the I. H. P. curve. The dotted line at the bottom of curve *dd* is to show the increase of thrust due to the friction of the forward set of engines when they were acting at low powers with the after set.

According to this curve the initial friction of the engine would be about 7.5 per cent of the load at full power.

ff is the "curve of the net resistance of the ship" as it results from the E. H. P. curve.

It will be noticed that undulation characteristic of the E. H. P. curve *aa* and of the net resistance curve *ff* at about 16.5 knots is faithfully reproduced on the I. H. P. curve *bb* and on the indicated thrust curve *dd*, giving strong evidence of the correctness and importance of the method of investigation devised by the late Mr. Froude.

Curve *cc* gives the ratio $\frac{E.H.P.}{I.H.P.} = p$, viz., the propulsive coefficient or the "net total efficiency of propulsion," which slightly increases at the higher speeds when it approaches to the standard value 0.50.

Curves *mm* and *nn* give the "coefficient of performance" for displacement and midship section.

Curve *gg* gives the ratio between the net resistance of the ship and the indicated thrust.

Curve *hh* gives a similar ratio when the initial friction of the engines is taken off from the indicated thrust.

All these coefficient curves *cc*, *mm*, *nn*, *gg*, *hh*, show more or less an undulation at about the same speed at which there is a marked change on the curve of E. H. P.

Curve *rr* in Fig. 3 (Plate VII) gives the I. H. P. in function of revolutions.

By the following method of investigation devised by Mr. R. E. Froude, and illustrated in his paper "On the Determination of Dimensions for Screw Propellers," read at the Institution of Naval Architects, 1886, I have approximately determined for the maximum speed of 18.38 knots the efficiency of the Lepanto's screw propellers, which would have an abscissa-value 10.75, very close to maximum efficiency. This abscissa-value and the corresponding net total

efficiency of propulsion are plotted on Fig. 4 (Plate VI), which is the reproduction of Mr. Froude's standard curve for the efficiency of screw propellers, as illustrated in his paper above mentioned.

With this abscissa-value the true slip of the Lepanto's screw propellers at the speed of 18.38 knots would be about 20 per cent, while the apparent slip is only 2½ per cent, leaving 17.28 per cent for the speed of the wake that follows the ship.

APPENDIX.

To comply with the wish expressed by Mr. F. C. Marshall in his remarks, I have given in Fig. 5 mean specimens of the Lepanto's indicator cards taken during the last three trials.

Regarding the performance of the Flavio Gioja's locomotive boilers, which was not so satisfactory as in the case of the Lepanto, it is necessary to bear in mind that the boilers worked under very different conditions in the two ships, especially on account of the different type of the engines. The Flavio Gioja having trunk engines, the cylinder condensation of steam was much larger than in the Lepanto, with the consequence that the boilers of the Flavio Gioja had to be overworked to give out the required power. This fact goes far enough to account for the difference in the results of the two ships, but some collateral circumstances came also into play, as for instance the less roomy and less comfortable condition of the Flavio Gioja's stokeholds, which prevented the boilers being so regularly and properly worked as in the Lepanto.

On the official trials, the engines of Flavio Gioja developed a mean of 4156 I. H. P., at the rate 14.35 I. H. P. per square foot of grate, with a consumption of seven tons of coal per hour, viz., at the rate of 55 pounds of coal per square foot of grate; the cut-off in the cylinders being 0.35, corresponding to a ratio of expansion 2.33. The consumption of steam, as shown by the indicator card, was about 23 pounds per I. H. P. per hour, viz. 10 per cent larger than that of the Lepanto for the same output of power per square foot of grate.

PARTICULARS OF TRIALS.

	1 April 4.	2 April 7.	3 April 11.	4 April 14.	5 April 28.	6 April 28.	7 May 5.	8 May 12.
Sea	Calm.	Calm.	Rather rough	Calm.	Heavy cross	Calm.	Rather rough	Calm.
Wind	Light N. W.	Light N. W.	Fresh N. W.	Light N. W.	Light S. W.	Light N.	Fresh N.	Light N.
Mean draught, feet	30′ 4″	30′ 4″	30′ 3″	30′ 3″	30′ 1⅛″	30′ ⅛″	30′ 3″	30′ 4″
Area of midship section, square feet	1 099	1,999	1,993	1,993	1,984	1,978	1,993	1,999
Displacement, tons	14,860	14,860	14,810	14,810	14,740	14,690	14,810	14,860
Wetted surface, square feet	36,500	36,500	36,430	36,430	36,325	36,255	36,430	36,500
Mean speed of ship, knots	7.25	13.7	13.3	14.4	15.89	16.78	18.18	18.38
Indicated horse power	1,004	6,230	5,714	7,385	10,330	12,010	15,260	16,150
Number of boilers used	2 Oval	8 Oval	8 Oval	4 Oval 8 Locom.	8 Oval 8 Locom.	8 Oval 8 Locom.	8 Oval 16 Locom.	8 Oval 16 Locom.
Number of engines used	2	4	4	2	4	4	4	4
Mode of action of engines	Compound	Compound	Direct	Direct	Direct	Direct	Direct	Direct
Area of fire grate used, square feet	94.1	478 4	478.4	Oval 239.2 Locom. 337.6	Oval 478.4 Locom. 337.6	Oval 478.4 Locom. 337.6	Oval 478.4 Locom. 675.2	Oval 478.4 Locom. 675.2
Heating surface used: Tubes.	3.488	13,952	13,952	18,896	25,872	25,872	37,792	37,792
Heating surface used: Total.	3,840	15,360	15,360	21,040	28,720	28,720	42,080	42,080
Mean steam pressure in lbs. per square inch: Oval boilers.	50	54	37	52	48	51	53.5	54.2
Mean steam pressure in lbs. per square inch: Locom. "	..	..	..	58	52	56	58.5	60.
Mean steam pressure in lbs. per square inch: Engine room.	48	51	34	47	44	47	49.	49.
Mean air pressure in inches of water: Oval boiler stoke holes.	Natural	0″.65	0″.94	1″.	1″.	1″.5	1″.	1″.6
Mean air pressure in inches of water: Locom. " " "	..	..	..	1″.9	1″.2	2″.5	2″.	1″.9
Cut off: In H. P. cylinders.	0.1	0.5	0.1	0 45	0.175	0.175	0.3	0.3
Cut off: " L. P. "	0 6	0.6	..	..	..	..	..	..
Ratio of expansion	11.1	3.8	5.56	1.89	3.93	3.93	2.63	2.63
Mean pressure in lbs. per square inch.. H. P. cylinders.	15.3	23.	15.4	36.62	23.5	26.1	30.65	31.9
Mean pressure in lbs. per square inch.. L. P. "	6 8	13.	..	..	..	..	..	..
Mean vacuum in condensers, inches	28.6	28.7	28.6	27.	27.5	27.5	27.	27.
Revolutions per minute	38.8	70.53	68.73	74.25	80 95	85.	92.05	93.5
Apparent mean slip, per cent	6.4	4.25	4.6	3.8	2.7	1.8	2.34	2.72
Mean speed of piston per minute, feet	252.2	458.25	445.25	484.27	526.5	552.5	598.	607.75
I. H. P. per square feet of grate	10.7	13.	11.9	12.8	12.6	14.6	13.1	14.
Heating surface per I. H. P., in square feet: Tubes.	3.48	2.24	2.45	2.55	2.5	2.17	2.46	2.34
Heating surface per I. H. P., in square feet: Total.	3.82	2.47	2.69	2.84	2.78	2.41	2.74	2.61
Coal used per hour, in tons	0.9	6.4	6.9	11.4	13.7	16.8	21.8	23.5
Coal used per I. H. P. per hour, in lbs.	2.02	2.27	2.75	3.45	2.97	3.14	3.2	3.3
Coal burnt per square feet of grate per hour. Oval boilers, lbs.	21.3	29.9	32.3	34.	35.	38.	33.	38.
Coal burnt per square feet of grate per hour. Locom. " "	..	..	..	51.	41.	58.	49.	51.
Steam used per I. H. P. per hour as shown by indicator cards	16.1	15.	18.2	22.2	18.4	18.2	21.1	20.7

FIG. 1.

Arrangement of Engines and Boilers.

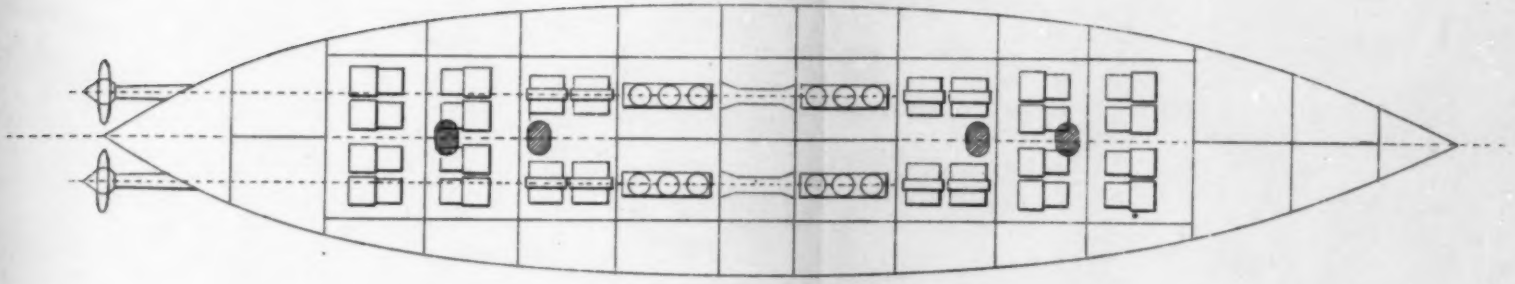


FIG. 4.

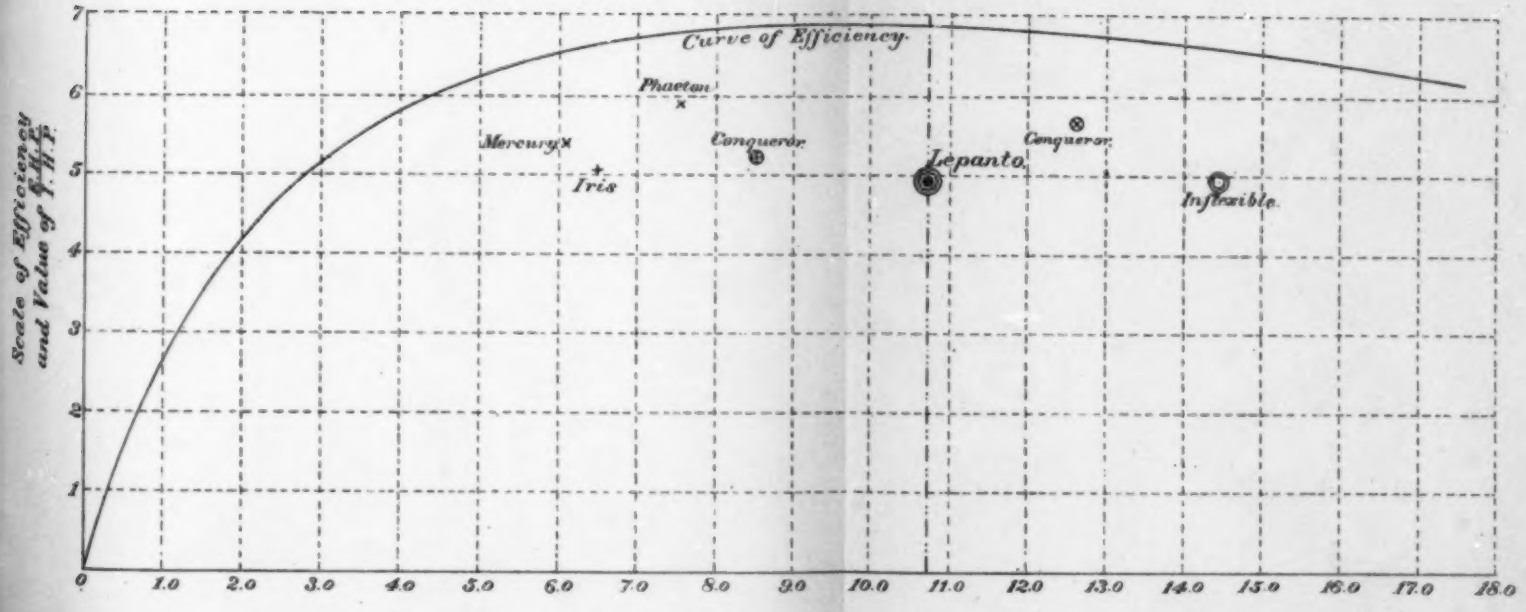
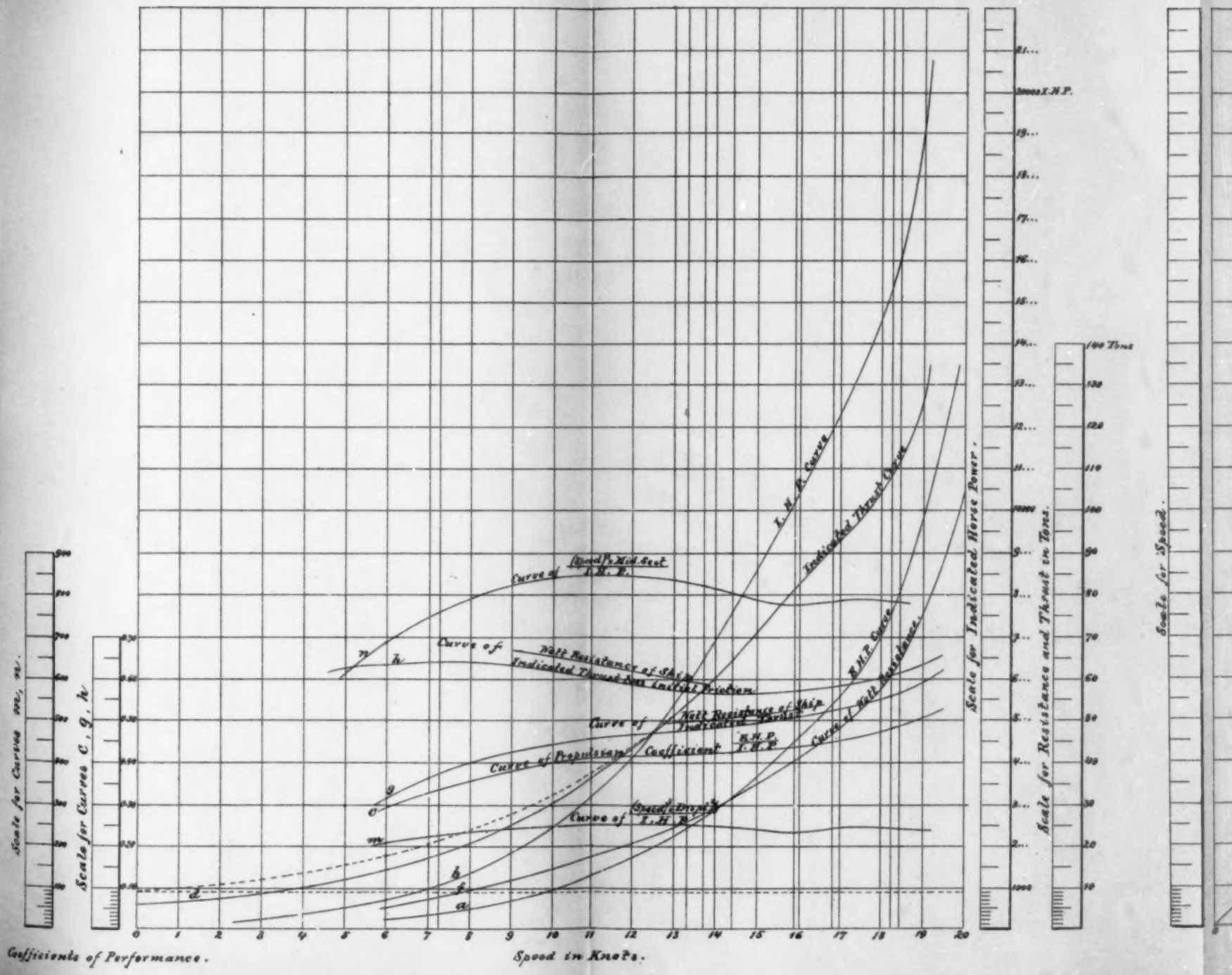


FIG. 2.


Scale for Curves m, n.
Scale for Curves C, f, h.
Curve of Speed P. Mid. Seat I.H.P.
Curve of Nett Resistance of Ship Indicated Thrust less Initial Friction.
Curve of Nett Resistance of Ship Indicated Thrust
Curve of Propulsive Coefficient I.H.P. / S.H.P.
Curve of Speed² Drop² I.H.P.
I.H.P. Curve.
Indicated Thrust Curve.
S.H.P. Curve.
Curve of Nett Resistance.
Scale for Indicated Horse Power.
Scale for Resistance and Thrust in Tons.
Scale for Speed.
Coefficients of Performance.
Speed in Knots.

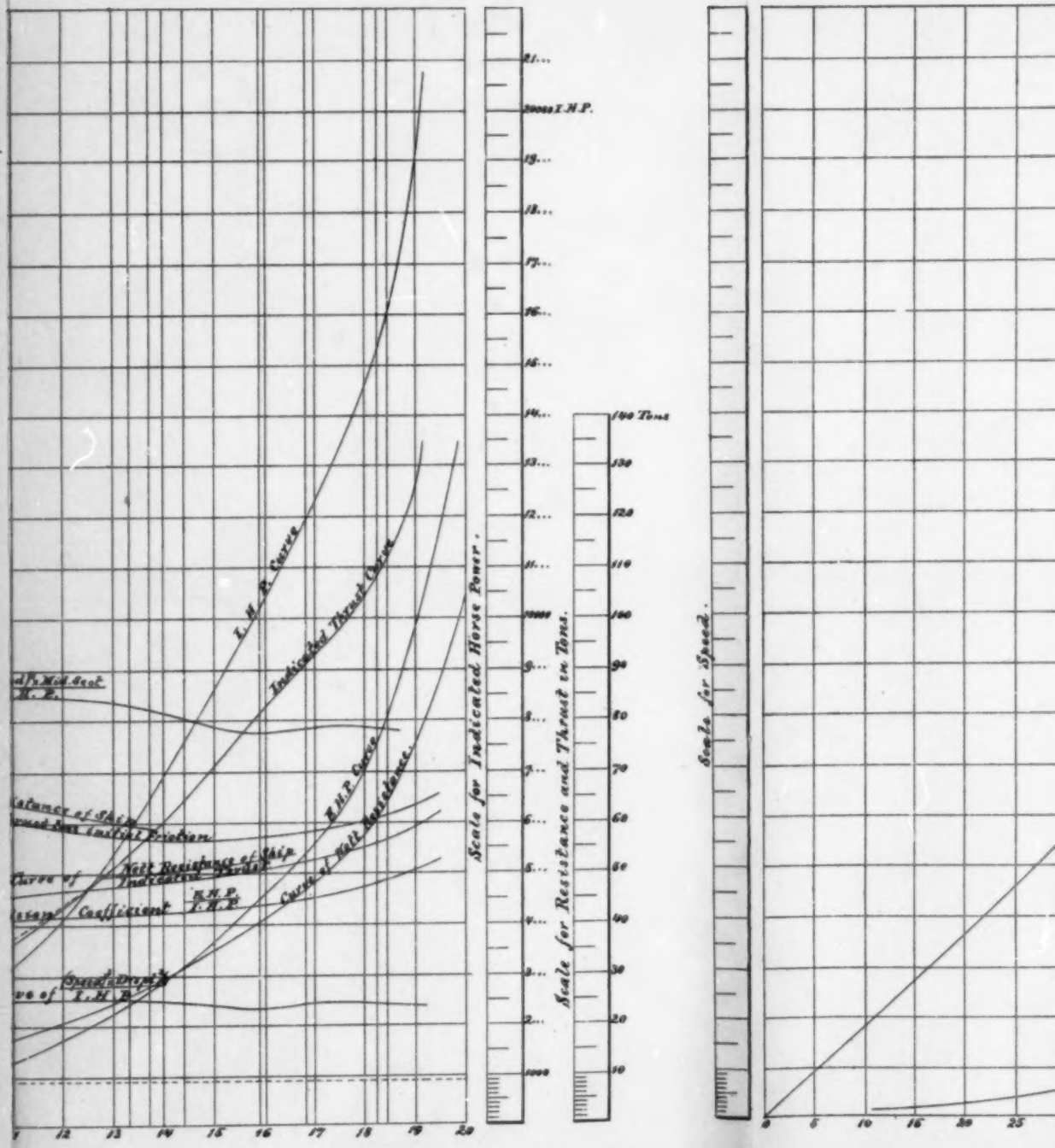

I. H. P. Curve.
Indicated Thrust Curve.
I.H.P. Curve.
Curve of Hull Resistance.
Scale for Indicated Horse Power.
Scale for Resistance and Thrust in Tons.
Scale for Speed.
Knots.

FIG. 3.

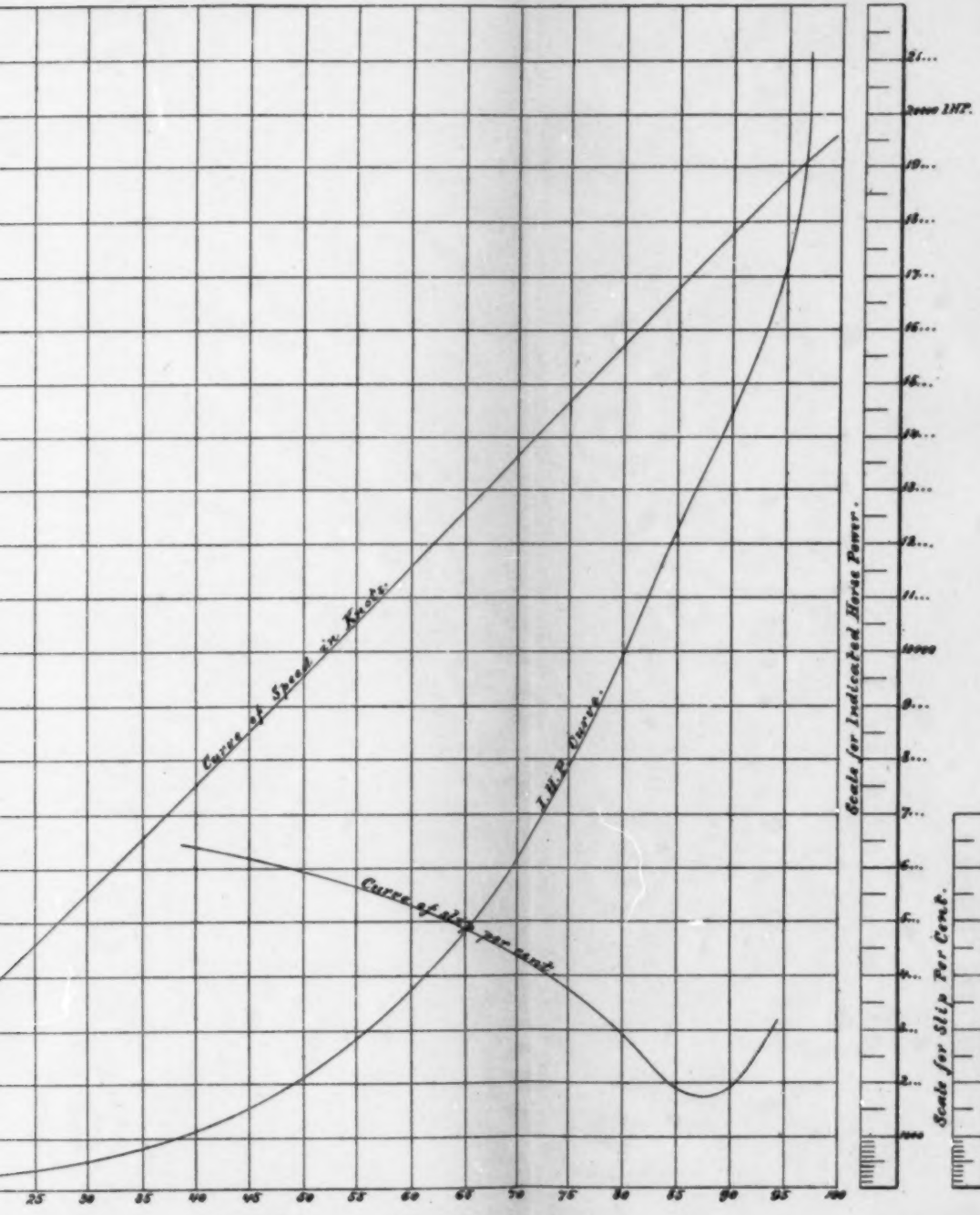
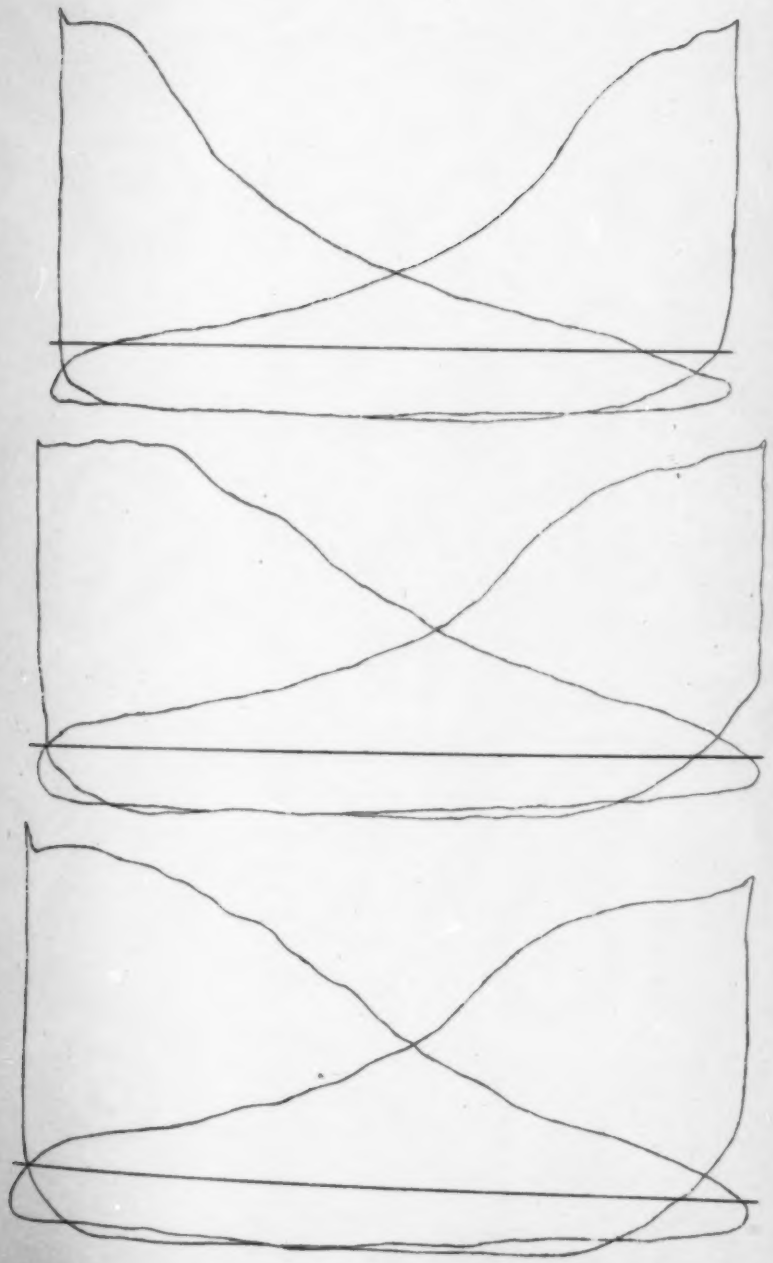

Curve of Speed in Knots.
I.H.P. Curve.
Curve of slip per cent.
Scale for Indicated Horse Power.
Scale for Slip Per Cent.
Revolutions per Minute.

FIG. 5.

Average Cards taken during the Trials
Scale $\frac{1}{24}$



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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

NOTES ON THE MANAGEMENT OF BOATS IN THE SURF.

By A. A. Ackerman, Ensign, U. S. N.

The literature on the subject of surf-boating is so scanty and contains so little practical information outside of a few general rules, that the following notes are presented with the hope that they may be of use to the service, rather as suggesting the need of a comprehensive description of the surf and method of passing it in all parts of the world, than as a manual for any one locality. An examination of all the works on seamanship and boating discloses only a few axioms, so stripped of detail as to be of use only to those well acquainted with all the difficulties likely to be encountered. If one succeeds in following these terse directions he may get ashore dry, but the surf rarely allows time either for reflection or for the application of any but almost instinctive methods. A very large amount of information is in the possession of officers whose opportunities for observation have been good, but it is seldom that surf-boat duty has continued long enough to give the average officer more than a keen appreciation of its uncertainties. These notes are founded on an experience extending over three years on the U. S. S. Ranger: during this time hundreds of landings were made by the officers on the west coast of Lower California and Costa Rica, for the purpose of erecting signals and carrying on the triangulation. In addition, the coast was followed, and its outline and topography fixed for over three hundred miles; information as to the effect of peculiarities of the shore was thus obtained.

Generally speaking, the surf differs almost as much as the other features of the coast. It is modified by currents, outlying rocks, shoals, river bars, the curves of the coast, and the kinds of beach,

whether steep to, sloping, rocky, or sandy. Again, it changes every hour of the tide and with every variation in the force and direction of the wind and ocean swell. The way of passing it in each case must differ somewhat if the best results are to be obtained, and so in different localities the surfmen have their own peculiar methods, governed by the character of the surf, the objects sought in passing it, and their equipments.

It is difficult to compare surfs at long intervals of time and at widely distant points, hence the question whether a landing can be safely made or not will frequently be left undecided until the shore is reached. Even then chance may have played so important a part in the operation that the rule may be laid down never to attempt a landing without taking every precaution for safety in case of being capsized.

From the ship, a mile or two off shore, the surf may seem uniform, and opinions may differ as to the best landing place. Patches of sand beach will alternate with bluffs, below which lie rocks and debris, sometimes only shown in the churned-up surf when dangerously near. The débris is often swept by the combined action of the surf and current into the form of an irregular breakwater towards the lee side of the bluff. This shoal being of varying height and lacking continuity, may be of little help when covered by the flood; but at low water its influence is at once apparent. The sand beach begins below this point, back of the face of the bluff, perhaps marking an ancient river mouth, with even now a weak stream seeping through the sand and shingle piled up by storms and surf. This is washed away every time the river rises, leaving a shallow recess in the beach. The best landing may be looked for at such a point. It may even be possible to zigzag in between the bluff shoals and river bar.

For the same reasons narrow cañons in long stretches of bluff sometimes mark quiet spots, but are dangerous on account of the boulders washed down by the streams.

On a long stretch of sand beach it is difficult to make a choice, but it is certain that wherever a shoal appears or the surf stretches far out, there will be found a comparatively light surf on the lee side.

Pockets in a rocky coast sometimes show tempting beaches at their bottom, but should not be entered until carefully inspected. They frequently contain sunken rocks; the surf is treacherous, and the most skilful crew trapped in such a place may find it impossible to avoid disaster.

A single rock, hardly far enough off shore to be shown on the chart as separated from the beach, will frequently have a quiet place in its lee, although the approach to it may be dangerous at times.

A confused surf off the mouth of a lagoon or river, or the slanting breakers which sometimes run along the beach, had better be avoided unless low, as the boat may be filled by cross surf while pointed to receive the main breakers.

The more or less regular recurrence of the heaviest breakers, the point at which they become dangerous by commencing to break, and that at which they become comparatively harmless by falling into confusion, should be considered. A heavy breaker arriving at regular intervals, rising and curling only to fall to pieces, may be dodged, but if it is carried a long distance, the probable effect on the boat in passing it must be taken into account.

The number of lines of breakers or width of surf does not always determine the danger of landing, as the outer lines will be much the heaviest and may frequently be avoided.

Notice should always be taken before entering the surf of the probable drift of the boat; it may be set by the current down among rocks or into heavy surf.

The beach may present obstacles apart from the surf. It is often difficult to climb a steep shingle beach at high water even without being obliged to drag the boat clear of the breakers. At the same place a good landing may be made at low water on the uncovered sand slope below the shingle. A ledge of rock cropping out through the sand beach, or scattered boulders, sometimes endangers the boat's bottom. In such cases there are but two ways of landing. The preferable one is to make the passengers jump and wade ashore the instant the boat touches, hauling out at once through the surf. The second plan is to order everybody out of the boat as soon as a foothold can be secured, to steady and protect it. The first big swell should be utilized to land the boat as high upon the rocks as possible. Often the boat reaches a rocky beach nearly full of water; should it touch a rock while in this condition the consequences would be disastrous. Circumstances must decide whether it is better to paddle and drift along in the inshore surf while the boat is being bailed out, or to hold it in one spot until ready for landing or going out again.

A surf crew, exposed to unusual hardship and danger, constantly wet and frequently losing their meals, deserves great consideration

aboard ship. The men must not only be trained to act powerfully together like a racing crew, but each one must quickly recognize the necessity for individual action and perform his part without special orders from the coxswain. No racing crew has more need of utter subservience to their coxswain—obedient at the instant, yet possessing the intelligence necessary for independent action.

Disaster is most certain if the attempt is made to pass heavy surf with inexperienced men; in fact, a single raw hand may jeopardize the whole crew. Sometimes the new man may be dazed and sit quietly without working, which is perhaps best for all hands; others select the critical moment to adjust their trailing lines or foul the oars. Excitable ones may sing out and even try to direct the handling of the boat, so greatly do they feel the need of action. The boat officer should recollect that frequently the coxswain has had much more experience than himself, besides, from his elevated position and feel of the steering oar, he knows better both the position and tendency of the boat. To deprive him of the right to direct momentarily would be to impair his efficiency. Unless the boat officer takes the steering oar himself, he should be content with the selection of the place and time of landing. He will have time often to decide and direct whether to take or run from a breaker, but almost all else will be too quick for anything but the instinctive action of coxswain and crew.

A crew may be gradually trained in light surf. Should they meet with a few harmless capsizes, so much the better, as they will find it not so very terrible after all if they succeed in escaping bruises from the flying oars. Above all, the crew should have confidence in their coxswain and boat officer. Whatever is attempted should be done unflinchingly; vacillation or alarm in either of them will reflect itself instantly in the faces of the crew. The latter, low down and with their backs to the surf, can form no correct idea of their danger. Before entering the surf at a strange locality, it is well to lie off it for awhile, noting its peculiarities and accustoming the crew to them. Dangerous breakers may pass, but the quieter intervals are very encouraging.

The matter of life-boats has been much agitated of late by those interested in the various designs, and though the requirements of a good surf boat differ materially from those of a deep-sea life-boat, yet they are alike in some main particulars. A boat combining in a high degree the qualities of both can be built, the objectionable dif-

rerences being removed or lessened whenever it is used for one or the other purpose. Along shore two life-boats are used, a heavy one, non-sinkable, self-righting and bailing, requiring ways for launching or a harbor from which to start, and a light, non-sinkable, self-righting boat. The former, however satisfactory in making a passage at sea, where its best points are shown, of course could not be handled by its unaided crew on the beach. Its weight, slowness under oars, and large crew are also great objections to its use for ordinary ship work or life-saving at sea, where the handiness of a light boat and small crew has been none too quick to save life on many an occasion. Every one has noticed how much more difficult it is to pick up an object on the water in a moderate sea with a heavy boat and large crew than with a light boat and small crew. The light surf boat, depending more upon the dexterity of its crew to avoid danger, still possesses no mean power of its own through sheer and buoyancy to keep the water out.

A life-boat's crew, though composed of picked men, have but little power compared with the forces against which they are sometimes obliged to contend. Though their boat may be self-righting, self-bailing, etc., so long as it is not self-propelling and self-directing, its weight must be kept down and handiness in steering made a prominent characteristic. Without these latter qualities the former are made absolutely necessary, for though the boat will doubtless perform its righting and bailing functions with clock-like precision, it is unable to avoid danger. Its destination is reached only after the expenditure of an enormous amount of labor and much precious time.

The qualities of a surf boat should include:—

1. *Great sheer, with upper strakes flaring at bow and stern*, to keep out as much of the crest of a passing breaker as possible, to support the boat when lifted by a wave, and to prevent the ends dipping under when sliding down a wave. For the same purposes, and to assist both bow and stern in buoyancy and consequent quick movement in answer to rising waves, weights should be kept out of the extreme ends of the boats.

2. *The submerged part of the boat should offer the least possible resistance to turning.* A wave, in broaching a boat to, acts on all parts of it similar to fixed rudders, keel, forefoot, run, and side. To resist this the coxswain relies upon the leverage of his steering oar. If the bottom of the boat is rounded and smoothed off in every

direction, regardless of arbitrary rules of beauty or dismal prophecies, a type is obtained on which the water has the least hold for turning and the coxswain the greatest for directing. It will be almost a miracle if a heavy keel boat, once slightly turned and being carried back on the face of a breaker, can be righted unless the crew is well trained and succeed in holding it until the breaker slips under. The critical period with a keel boat in such a case is extremely short, for it catches at once on the under dead-water and trips as it is carried back until the gunwale dips under and the boat capsizes. A very light, smooth-bottomed boat, however, is sometimes swept along before the breaker without capsizing. An incident comes to mind in which this fact is clearly illustrated. A man was sent ashore from the Ranger one day in the dory; mistaking his orders, he pulled directly for a party on the beach instead of the usual landing place. It was high tide and the surf was very heavy, so heavy that on reaching the outer line of breakers he gave up his purpose, and was about returning to the ship, when a very large breaker, combing over farther out than usual, gave the boat such a spin that the man tumbled off his thwart. Before he recovered himself the boat almost stood on end on the side of another swell, and an instant later was inside the line of breakers. The man struggled vainly to rise; he no sooner sat up and groped for his oars than the boat, dancing about like a cork, threw him down again. It darted in one direction at some wave's impetus, then being caught again was spun around and sent off in another whirling and zigzagging. In this manner the boat came rapidly in, coquetting with the breakers, yet never caught and held. Near the shore the surf was lighter, and several breakers passed, each causing it to ship a few pints of water. The man landed almost dry. This dory was about fifteen feet long, with high bow and stern, considerable flare, and gave no more resistance to lateral motion in the water than the well-inclined smooth sides offered. It was impossible to pin it down with side pressure, as it evaded it by motion in direction of its length.

The upper bow should be quite sharp, though not lean, to part the breaker after the boat has risen as far as possible, rather than oppose a flat resisting surface, tending to throw it back.

3. *High freeboard, high, roomy thwarts, and favorable positions for oarsmen and coxswain in which to exert their strength.* No one who has seen the crew of a navy whaleboat struggling in a moderate sea but has condemned for all such work low, cramped thwarts,

crowded in the bow of the boat, and eighteen-foot oars inserted in rowlocks that clash and lose power on the back strokes. Swivel rowlocks should always be used when there is so great a chance of fouling the oars. The thwarts and rowlocks may be arranged so as to be shifted according to the duty; the lines of the boat should be such, however, that its speed and turning power is at its best when arranged for the surf. Then its propelling power should be nearly equally spaced about its centre of buoyancy, the thwarts three feet apart, the oars light and stiff. Passengers must stow themselves between the thwarts in the bottom of the boat. They should not be permitted to incommode the oarsmen, crowd the stern or foresheets, or sit upon the gunwale. The coxswain should have a platform sufficiently large to permit him to brace himself and use his strength freely on the steering oar. This should be broad, stiff, and not too long.

In most navy boats one-third, if not more, of the boat is taken up by the stern sheets, in which the cargo is carried. Of course, this load must always bear a certain relation to the weight of the crew, or the boat will not have her proper lines, being down at the head or at the stern, or in some one or more ways unfit for rough weather. To remove these objectionable features a radical departure must be made in the case of the surf boat. The cargo must be subordinated to the means of transportation, and so distributed as to increase the stability. The sides should be high enough not to take in water at every little roll or splash, and permit the crew to use their oars even when on the side of a wave. On troubled water, be it at sea or in the surf, a long oar is a nuisance. It cannot be handled quickly, it wears the men out, and in all its low length it is certain to strike on the back stroke, neutralizing its effect. If in addition it is springy, by the time the power is well applied in one direction the boat is turned or tilted and most of the stroke lost. The coxswain, too, is frequently loaded down with an oar, which, though excellent as a rudder, when the boat is pulled rapidly, must, when in the surf or moving slowly against a sea, be used as a lever for prying the stern around. It is evident, therefore, that we are reducing the coxswain's effective strength for steering by every foot we put upon the blade beyond a certain point. At that point, the water being supposed immovable, he exerts the greatest effort on the stern rowlock, when standing on his platform. The size of the blade and length of the oar should therefore vary with every change in the height of the stern.

4. *Lightness.* As a rule, navy-built boats are not sufficiently light for surf work or for any protracted pull in a seaway. The lighter and more buoyant the boat, the more facile its obedience to every impulse of the waves and oars, and herein lies much of its safety. Instead of crashing through or taking aboard waves as a heavier boat would, it rises nimbly over or slips around them, taking in little or no water. In landing or launching, the crew can handle it easily, dragging it quickly up stony beaches out of the reach of the surf. Above all, in a light boat the ratio of the weight moved to the power of the crew is less than in the case of the heavy one; and nowhere is this more evidently advantageous than in the ease with which the coxswain can direct it or the crew steady it on the dangerous side of a breaker.

5. *Strength* should not be obtained at the expense of lightness or any other desirable quality. It should be that of selected material and studied construction rather than of mere bulk. A surf boat is required to stand the shock of landing when full of water on bilge, stern, or forefoot, or on its gunwale when upside down, without opening its seams. It should stand the jar of a fall into the trough of the sea when sent at a good speed through a wave-crest, and support the rowlocks and thwarts with the men exerting their utmost strength. A towing post should be placed in the bow for veering surf line, and which may therefore be suddenly required to take the weight of the boat and its crew.

6. *Buoyancy.* Besides possessing natural buoyancy due to lightness, it should be fitted with air tanks, in bow and stern and along the sides under the thwarts, sufficiently large to support the boat full of water, crew, and cargo. An extreme type of surf boat would be similar to the Esquimau's kayak, in which there would be no room for water after the crew had taken their seats, all vacant spaces being filled up with tanks. A proper adjustment of the air tanks will render the boat self-righting; though that is of less importance in the surf, unless it is very wide and low. A crew once demoralized by being capsized, will hardly be able to regain control over their boat before it has drifted into the beach.

7. *Size and crew.* The larger the boat, if equally well handled, the less the effect of the breakers either for filling or capsizing it. On the other hand, a large boat is more difficult to handle. It requires more trained men; and the likelihood is not great that a crew will be preserved intact, despite sickness or other duty. Few ships

would be able to man a double-banked boat with surfmen. A single-banked, six-oared whaleboat may be taken as the economical type in which the best proportion of skilled power to resistance is likely to be obtained.

Even in combining the qualities required in a surf boat, it will be found that many concessions must be made. If in addition it is required to possess all the varied qualities of a ship's boat, or, in fact, any one of them seriously conflicting with its special purpose, the result cannot be satisfactory. The *combination* has failed; the surf boat, if it is given a fair trial, must be something more than that in name. The mean between pleasure and cargo-carrying craft, built, it would seem, merely to exercise as many men as possible, with little or no thought of the possibility of rough weather, should not be taken as the standard ship's boat. If a surf or life-boat is required to conform to them in almost any particular, it will do so only by the sacrifice of important characteristics. On the other hand, their functions can be performed by the latter; in many respects more efficiently. Great sheer and freeboard are undoubtedly serious objections in pulling or sailing to windward, but they may be mitigated by using removable washboards and ballasting the boat, while a side board may to a degree take the place of an external keel.

A description of the passage of heavy surf, using a one-hundred-and-fifty-fathom whale-line and ninety-pound kedge, will best show some of the difficulties encountered, especially those likely to arise from the use of a long line. All unnecessary articles are taken out of the boat. The water breaker is tightly plugged and lashed down, as are all stretchers and two buckets for bailing. The men shift into light clothes without shoes. If the weather is sufficiently cold to require it, dry clothing may be carried in the air tanks, which should, however, be carefully inspected and all unnecessary articles removed. A hatchet, copper tacks, sheet lead, and a roll of felting should also be carried for use in case the boat is stove. If the beach is distant, it is well to go under sail, so as to keep the men fresh, buoying the sails and spars over the anchor outside the surf.

After carefully inspecting the surf and beach, the landing place is finally selected. Perhaps it is an open, flat, sand beach, on which the breakers are rolling in heavily every few seconds. The question now arises, How far out will the surf line permit the anchor to be dropped? If let go just outside the breakers, it may be necessary to pick it up in them when coming out, through its having dragged, the tide

having fallen, or the swell increased. The anchor should be dropped far out, in order to give it plenty of room in which to drag. Moreover, as the coast current will sweep the boat down until the line tends over the bow, the longer it is for the same width of surf, the less angle will it make with the proper direction of the boat normal to the breakers. Having dropped the anchor, being careful to have it stocked, take in the bow oar, buoy sails, and pull in close to the outer breaker, turning around and heading out.

It is an open question whether any advantage is to be gained by making the after-oarsmen turn round on their thwarts. It is confusing, takes them from under the influence of the coxswain's eye, and, by making them face the surf, distracts their attention from the orders given behind their backs. In an expert crew, each man knowing his duty and performing it without special instructions, the advantages are all the other way; still, but few expert crews will be met with in the service.

On the verge of the breakers the bow oar hauls taut the surf line and sees it clear for running. The crew rests with oars apeak, the coxswain paddling gently to keep the boat headed out, waiting for the quiet spell that generally follows heavy breakers. Finally the heavy swells come rolling in, perhaps three of them, the second combing over just in rear of the boat. Veer as much as possible consistent with safety. To seaward all seems smooth outside the third breaker now speeding in. Its top grows sharper, and as it lifts and hastens, all along its lurching front is heard the seething of the spray. It strikes; the boat lifts to it, and almost at that instant its crest curves downward in a rounded sheet of falling water with a thundering crash. "Slack!" "Stern all!" and the boat flies in, the surf line humming out, and the men straining at the oars to preserve their position on the back of the wave. Ten seconds of this ride, and the friction of line and boat has retarded it sufficiently to let the breaker get away, but the long stretch of surf line on the foam-covered water behind is an encouraging evidence of the dangerous space passed. Now comes the crew's greatest need of experience and strength. Every effort is put forth to urge the boat in as far as possible before it is struck by the next breaker. Fragmentary and spontaneous breakers rise up in the troubled water, dividing or consolidating with others. In encounters with these the boat perhaps takes in a great deal of water. The surf line, nine-tenths of the time useless, retards continually. The boat has drifted down until the anchor is on the bow, and the

great bight in the line, paid out to hasten progress, shows that it can no longer be depended on. Now and then in the froth a great breaker gathers, and the question arises whether by pulling out it can be reached before cresting over, or by backing in hard the boat can be kept ahead until it falls. In either case the decision must be made quickly. Perhaps it cannot be avoided; the instant before it reaches the boat the order is given, "Hold water!" "Peak!" The bow oarsman having, if possible, hauled in the slack of the surf line, takes two turns and lies back. The men crouch, throwing their oar-blades high in the air; the coxswain steers to the last, but the instant the breaker is on him also crouches, lifting his oar as far out of the water as possible.

The breaker falls, and in a moment the seething foam and water is rushing by, seemingly high above the gunwale. The boat has cut off the top of the breaker and is half full of water. The bow oar has been thrown on his face by the weight of falling water and upward lift of the boat. It may be that the shock is so great that some of the crew are flung into the stern sheets. If the line is taut and the anchor holds, the breaker passes on, leaving the boat demoralized, but still able to hold its own in the lighter surf. A bight in the line is fatal; the boat moves bodily to the rear in the tumbling water, slowly turning and canting. But the instant the breaker falls, the oars can be used, and unless the water-logged boat is too sluggish, it is again brought head to sea. Stern all again, the passengers bail. Breaker after breaker passes until swirling eddies and light cross surf are met close to the beach. Each breaker has left its quota of water, and it may now be up to the thwarts, with the current setting the boat down the beach at a rapid rate. In this condition it is easily capsized if not landed end on and at once steadied by the crew. On touching bottom all hands peak oars, sliding the looms under the opposite rails to hold them clear of the water, and jump overboard, running the lightened boat up on the beach. Stray oars may injure some one or be snapped under the bilge: it takes too long to get them in the boat, but they can be instantly secured out of the way by peaking.

It is very important that the oars should be lifted clear of the water when the boat is struck by a breaker. It is impossible, even with a taut surf line, to prevent the boat springing back a little under the shock, when, if the oars are in the dead-water, they are almost certain to fling the crew on their faces and the coxswain overboard. At that

time oars are of no use; if the boat is not head on it is too late. It is impossible to row up such a perpendicular wall of water; but the instant the boat is lifted, whether it is being carried along or not, every available oar should be employed to direct it.

In going out, the time of start, though important, is less so than when coming in, as it may be possible to pull half way out without fear of meeting dangerous surf. If a surf line is used, take the boat up the beach until it appears that when carried down by the current and hauled out at the same time it will reach the dangerous space with the line fair to the anchor. Station two active, powerful men to haul in the line, as more progress will be made in this way than if they took oars. The four after-oarsmen steady the boat, standing in the water opposite their thwarts, oars apeak. Put the passengers aboard, haul taut the line, and commence walking out the boat, the coxswain at the stern. As soon as the boat leaves the bottom the men climb in and take their oars, pointing them to prevent drift until ready to start. The intention is so to time the arrival of the boat at the outer line that no heavy breakers will be met at that point. Varying width of surf and speed of boat makes this difficult of attainment.

At the start the men pulling and hauling force the boat rapidly through the water. Irregular waves splash into the boat; later they become too large to be pulled through without taking much water aboard. It is then best to check headway, tauten the line, and peak oars as the breaker passes. So the boat works out, obviously passing many more breakers than when coming in. Gradually the filling boat becomes sluggish, difficult to pull and steer. In this condition it is almost certain to be capsized if slightly turned. The admirable buoyancy and quickness is gone; it scarcely rises to the swell, but dumbly takes every swash aboard. Or, suppose while still in the midst of the surf the current has swept the boat below the anchor. The line now tends over the bow and can no longer be used; indeed, it is a source of danger, its bight tending to turn the boat even when allowed to drag freely.

It is now better to go back, bail out, and try again, than to struggle on and risk an almost certain capsize in the heavier breakers. The idea is prevalent that to pass a breaker it is necessary to charge it. That is the safest policy only before or at the instant the swell breaks, or in case a breaker is so light that it is certain the boat will ride it. A properly pointed boat will suffer less

disorganization if permitted to await a heavy breaker which it cannot hope to ride, than if it is rammed into it. In either case the crest will fall into the boat, which will be swept back some distance.

With men who can swim, and a good buoyant boat, a capsize is not necessarily a dangerous accident unless it occurs far out, in very heavy surf, or when the surf line is used. The latter is always a danger in going out. Suppose the boat has reached the outer line of breakers into which the anchor has dragged: owing to the current it is impossible to strike it fairly, and the line will have to be underrun, seriously exposing the boat for some moments. Caught in this predicament, it may be necessary to cut the line in order to get out. Or, suppose just at the last moment the boat capsizes, with one hundred and fifty fathoms of surf line loosely coiled in the bow and a couple of turns around the towing post. Bights fall through one another, and after the rolling boat has been swept in twenty to fifty fathoms, an immense knot forms somewhere under the surface, holding it in heavy surf. The men right the boat again and again, endeavoring to free the line, but their strength becoming exhausted, one after another is torn away and swept on toward the beach—lucky indeed if they succeed in reaching it. In such a case the line should be cut at once; the possibility of clearing it may be discussed afterward. A *buoyant* boat will come in to the beach with the crew hanging on almost as fast as the breakers.

There are occasions when a surf line may be absolutely necessary, as when veering in a heavy boat; but it always creates special difficulties and dangers. It pulls the bow down when rising to a heavy swell, and if the sheer is great, tends to capsize it around its longer axis. Though excellent for a few seconds when going ashore, after that it is a nuisance, cumbering the boat and increasing its weight. A knife or hatchet should always be at hand, ready to cut it in case it jams, the boat capsizes, or it is necessary to abandon the anchor.

Many of these objections apply to the drogue, which, though useful to *steady* sail and rowboats moving rapidly in a wide but moderate surf, is not of much account when the surf is narrow and heavy. This is because its resistance, increasing only with motion, does not accumulate until the boat has been carried back and perhaps capsized. The ability to trip renders it unnecessary to carry a very long line, but then it is necessary to drag it after the boat when inverted.

Surf is dangerous, according to the boat and crew, when it is able

to sweep the former back on its face in spite of the efforts of the latter. With a smooth-bottomed boat and skilful manœuvring it may be possible to escape capsizing, but at such a time nothing can take the place of a surf line and well-bedded anchor.

PROFESSIONAL NOTES.

WEST POINT, N. Y., *September* 6, 1889.

TO THE SECRETARY U. S. NAVAL INSTITUTE,
ANNAPOLIS, MD.

Sir:—Captain W. T. Sampson, in his excellent article on the Naval Defense of the Coast, published in the July issue of the Proceedings of the Naval Institute, takes occasion to depart somewhat from the strict limits of his subject, to explain why the Board on Fortifications and Other Defenses did not provide for the defense of the eastern entrance to Long Island Sound at the Race by forts. In making this excursion from the main line of his argument, the Captain has unintentionally misstated a paper read by myself before the Military Service Institution, and, in consequence of this error on his part, I am prompted to ask permission to make the proper correction.

The portion of Captain Sampson's paper to which I refer is the following: "A paper read before the United States Military Institution criticises the 'Board on Fortifications and Other Defenses' for not defending this passage [the Race] and thus protecting all points within the Sound, including New York itself. The Board was of the opinion that an enemy could not be stopped at the Race by fortifications, and, as the Board was organized to make practical recommendations, I think it wisely placed the defenses where they were confident the enemy could be stopped [at Throgg's Neck].

"The recommendations of the Board did not present the beautiful simplicity of the plan in the paper above referred to, in which 20-inch guns are advocated for each side of the Race."

I pass by in good humor the doubtful compliment ensconced within the passage quoted, and beg simply to say, purely by way of correction, that the paper referred to did not advocate 20-inch guns for the defense of the Race. It did state that, in the judgment of the writer, the Race could be defended from the shore, and, since the publication of the paper, this has been confirmed by the statement of one of the best practical military engineers of our country, after a personal inspection of the point. A reference to page 181 of the paper as published will show that the writer considered guns of no larger caliber than 17.5 inches to have sufficient power to close the Race against anything carrying 20 inches of steel armor, or its equivalent, or less.

If the quotation means to imply that it is impracticable to mount guns as large as 20 inches caliber at important points on our coast, I am in position to answer that I have accurate information that at least one firm of gunmakers (Krupp) can produce guns of this size, and so good an authority as Gen. Abbot advocates "the largest possible gun" for coast defense.

Captain Sampson makes another error in treating of this matter, to which attention should be called. He assumes that the Race can only be defended by forts from Fisher's and Gull Islands. In this he has clearly overlooked the fact that Valiant and Race Rocks stand in the interval between these islands and offer typical sites for turret forts. If these rocks be occupied, the range would be reduced to one half that given by Captain Sampson, or to such as would require a hostile vessel to run within one mile of the guns of the forts. It must be admitted that better conditions than this for land defense cannot reasonably be asked for.

It is a difficult matter to fix in a definite way what amount of defense, whether land or water, will "stop" and what will not "stop" an enemy, but it may be accepted as a fact that if this point were fortified as proposed, no ship could pass in through the Race without being exposed to fort fire at point-blank range, and to a thoroughly effective fire for some time before and after passing through the Race.

In reference to the point made that the enemy's man-of-war might make a sudden dash through the Race under cover of fog or darkness, since, on account of the swiftness of the current, torpedoes cannot be planted, it may be said in reply that the waterway leading up to the mouth of the Race might be rendered so tortuous by sunken obstructions as to effectually estop any such procedure. But, this aside, would a ship venture into such a *cul de sac* as Long Island Sound with the "choke" at Throgg's Neck and the Race held by the enemy?

It would seem, therefore, that the interior position at the Race might very well be left to the artillery, while the navy would have the more important exterior lines to look after from Montauk Point to Block Island, from Block Island to Nantucket Island, and from Nantucket Island to Cape Malabar.

Very respectfully,

E. M. WEAVER, *1st Lieut. 2d Art'y.*

Lieutenant Weaver refers to page 181 of his paper as published to show that he did not advocate 20-inch guns for the defense of the Race. On page 180 of his paper, Vol. IX, No. 134, *Journal of the Military Service Institution*, he says: "Therefore for the purpose of this discussion a 20-inch gun is assumed as the standard gun for the defense of our outside line."

There are seventeen feet of water over Valiant Rock; it may be a possible but is hardly a typical site for a turret fort.

The following quotation from Abbot's "Defence of the Sea Coast of the United States" shows why floating defenses are considered necessary for the Race: "One question formerly stoutly contested has been practically answered so many times in late years that there is no longer any difference of opinion upon the subject; every one now admits that a fleet can force a passage past a line of batteries of equal or even of superior armament, provided the channel be unobstructed." R. W.

OPEN LETTER

ADDRESSED TO THE AMERICAN DELEGATES OF THE INTERNATIONAL MARITIME CONGRESS BY THE PROVIDENCE AND STONINGTON STEAMSHIP COMPANY.

Prepared by Lieut.-Commander E. H. C. Leutzé, U. S. N.

Based on the Experience of the President, Captains, and Pilots of the Company.

TO THE AMERICAN DELEGATES OF THE INTERNATIONAL MARITIME CONFERENCE.

Gentlemen:—It is expected that the International Maritime Conference will adopt new rules for the prevention of collisions at sea, new regulations for lights of vessels, fog signals, etc. In the event that these international rules are suitable for our purposes, we intend to petition Congress to make the rules and regulations that govern United States vessels in United States waters the same as the international ones, as simplicity and uniformity in such rules seem to be of the utmost importance. For this reason we beg to submit to you our views on these subjects. They are based largely on personal experience

and on the experience of the captains of our steamers, and we hope that they may receive due weight in your deliberations.

GENERAL DIVISION I.

1. Visibility, number, and position of lights to be carried by vessels.

(*a*) Steamers under way.—We consider the lights carried by the Sound steamers as required by Rule 7 of United States excellent in every respect. The "central range" of white lights we consider of the utmost importance, for when end on, or nearly end on, the course of an approaching vessel can be seen to within one point of the compass, and the slightest change of course is immediately detected, and all this without reference to the side lights. When vessels are crossing at right angles, or nearly so, the course cannot be told so closely, but it is then not of the same importance. For that reason the actual position of the lights need not be accurately known, as long as we are sure that the lights are not less than a certain horizontal distance apart, and that the after light is not less than a certain number of feet above the forward one. Should it become a question between the central range and side lights or double side lights, we would strongly favor the former.

If it should be decided that neither of the central range lights be visible all around, as is likely to be the case, on account of masts, smoke-stacks, etc., we would then recommend a white taffrail light in addition, the same to show over an arc of 180° from right abeam around the stern to right abeam.

We do not favor the adoption of distinctive lights for steamers of different speeds, as there seems to be no necessity for them.

We would here call attention to the fact that the captains of our vessels have had actual and constant experience with the "central range" for a number of years, and are therefore excellent judges of their value. They are unanimous and strong in their opinion that they are the best guide for judging a vessel's course or change of course.

We would also invite the Conference to investigate the matter of search lights for steamers. We are of the opinion that, when shaded with a red screen and thrown vertically, they may often be useful in determining a vessel's position in a fog. We base our opinion on this fact, viz.: This company furnishes the lighthouse keeper at Beavertail with red fire, which he burns during foggy nights about the times when our steamers are expected. The loom of this red fire is seen before the lighthouse, or when the lighthouse cannot be seen at all; it is also seen before the fog signal is heard.

(*b*) Steamers towing.—We think that they should be distinguished from other steamers by having the after range consist of two lights carried one above the other.

We also think that all vessels being towed should carry two white lights, one above the other near the stern, a certain number of feet above the deck, and visible all around the horizon.

It is very difficult at present to distinguish the rear vessel of a long tow (such as formed by coal barges, which tow with very long lines), and there are cases on record where vessels have run foul of the long tow lines, as the vessel astern could not be distinguished as belonging to the tow.

(*c*) Vessels under way but not under command.—For this purpose we consider the steam whistle sufficient. A sailing vessel could use her instrument for making fog signals for the same purpose, or the rapid ringing of the bell might be adopted. We have no views in regard to cable steamers, as we do not meet them.

(*d*) Sailing vessels under way.—There seems to be no reason why a sailing vessel should not carry a central range of white lights like a steamer. One of the range lights of either steamer or sailing vessel could have a distinctive feature by which one could be told from the other. Should, however, the "right of way" of sailing vessels be taken away, then there seems to be no absolute necessity for this distinctive feature.

Should the "central range" be considered objectionable, we would then strongly urge that a sailing vessel carry either a bright white light visible all around, or else a white mast-head light visible over 20 points, from right ahead to two points abaft beam on both sides, and a white taffrail light visible over 16 points from right abeam, round by the stern, to right abeam on the other side. The correct principle to start with seems to us, the smaller the vessel, the brighter the light.

It may be urged that the single white light might be mistaken for that of a vessel at anchor, but this does not seem to be any real objection, as objects to be avoided are marked in both cases.

(*e*) Sailing vessels towing.—Should two white lights be the distinctive mark of a steamer towing, we then think that a sailing vessel doing the same work should carry the same distinctive mark, in addition to her regular lights, if she carry no white light; or in place of the one white light, if that is adopted; or in place of the upper range light, in case that is adopted.

(*f*) Vessels at anchor.—They should carry a bright white light visible all around the horizon.

(*g*) Pilot vessels.—They should carry their regular lights (steamer or sailing vessel), and should in addition burn a flare up or flash lights at regular intervals.

(*h*) Fishing vessels.—As these vessels are practically at anchor, we think they should carry the lights of vessels at anchor.

We would add that the lights should be of a certain minimum power, all colored shades should be of a certain standard shade, and all lights should be subject to inspection at any moment, and a fine should be imposed if they are found dirty or wanting in any respect.

2. Sound signals; their character, number, range, and position of signals.

(*a*) For use in fog, mist, falling snow, and thick weather as position signals.

For steamers under way.—It seems to be the consensus of the opinions of our captains, that for steamers pursuing a course, one long blast of the whistle, say of 8 seconds' duration, at intervals of 30 seconds, is the simplest and best signal that can be devised. In this connection we would recommend that some automatic machine for blowing the whistle, with blast of equal length and at regular intervals (Crosby machine, for instance), which can be instantly used by hand, would be an excellent appliance to each steamer, as at present the whistles are blown very irregularly.

We would recommend a very deep or chime whistle as one to be heard best, and would have only one for all purposes. (We must state that we have had no experience with the steam siren that is now fitted to many ocean-going steamers.) The range of the whistle should be about 10 miles in acoustically clear weather; we make this qualified statement as it is a well-known fact that, under certain conditions of the atmosphere, any fog signal, no matter what its range is, is unreliable as to distance and as to direction, and this unreliability decreases as the sound instrument increases in force.

The instrument for making the signal should be situated so that the emitted sound waves shall be as little obstructed as possible by surrounding objects, such as smoke-stacks, masts, or boats. It should be situated as high as possible, and, if practicable, it should be revolving, so as to emit sounds in all directions.

We favor one whistle only, as being less liable to confusion. If there are two whistles, they might be mistaken for separate vessels. Besides, no whistle has the same sound at all times, the difference in tone being caused by different pressure of steam or amount of water in pipes after having been unused for some time.

It is also the consensus of the opinions of our captains, that it is not necessary to have separate signals for vessels standing in opposite directions in narrow channels.

They think it might be well for sea-going vessels to have a code by which

one of 8 points (cardinal and quadrantal points) can be signalled, and that, if such code is devised, the vessel signalling such a point should be obliged to steer that course. In no case should any signal be introduced into this course, which may be adopted as helm signal or any other purpose.

For steamers towing.—Steamers towing should have a distinctive signal. We would recommend one long and two short blasts of the whistle. This signal should not signify anything else. We would also recommend that the rear vessel of each tow should make the same distinctive signal with her horn as the towing steamer makes with her whistle.

For sailing vessels under way.—We are of the opinion that a sailing vessel should be obliged to carry a powerful horn, which is to be blown by mechanical means. The least amount of power should be fixed by law, and all horns should be inspected and stamped by the inspectors.

We are also of the opinion that the present fog signal indicating the tack a sailing vessel is on, is of no value. During light winds it is almost impossible, on board of a fast steamer, to judge the direction of the wind correctly. The rule also requires too much thought for a matter which has generally to be decided at a moment's notice.

We think that they should make the same signals with the horn that a steamer would make with her whistle.

Sailing vessels towing.—They also should make the same signal with the horn that the steamer makes with her whistle.

We would here state that we are aware that a more complete code of signals could be devised which would often be convenient, but it would be at the cost of simplicity, and that, as before stated, we consider of the greatest importance.

For vessels at anchor.—The present rapid ringing of the bell seems to be a good signal; the minimum size and tone of the bells should, however, be established by law.

If it should be desirable, we see no objection to substituting a powerful gong for the bell.

Vessels under way, but not under command, including steamers laying cables.—As they are on a par with a vessel at anchor, the same signal would seem to suffice. A steamer could indicate this condition by a continuous blast of the whistle.

(*b*) For use in all weathers as helm signals only.

For steamers meeting and crossing.—We consider the present pilot rules for United States waters good. One short, decisive, blast of the whistle should mean, "I am directing my course to starboard," and two short, decisive blasts, "I am directing my course to port." It is of great importance that these signals should not be used for any other purpose, and should not be included in any code of signals devised to denote a vessel's course during thick weather.

Vessels before turning a sharp curve in a channel where an approaching vessel might be hidden from view should sound a long blast of the whistle at least half a mile before reaching such a curve.

For steamer overtaking.—We do not consider the present arrangement in the United States rules good. In this case, the steamer being overtaken has to answer the same signal which she hears, and would then not be able to steer as she indicates by whistle. For instance, if the overtaking steamer gives one blast of the whistle, she means, "I am directing my course to starboard"; the vessel being overtaken now answers one whistle, which in this case would mean, "I understand; I will let you pass, and, if necessary, direct my course to port." We would suggest that some signal be adopted for these cases, which would mean "I understand," and which should be immediately followed by the whistle, indicating which way the helm is put or which way the ship's head is altered.

For steamers backing.—Three short, decisive, blasts of the whistle should signify, "I am stopped," and should include, "I am backing."

It seems to us that this signal deserves careful consideration; it should be specially stated if "I have stopped" or "I am backing" should refer to the vessel or to the engine.

(*c*) Whether the helm signals shall be made compulsory or remain optional. We are strongly of the opinion that they should be compulsory in all conditions of the atmosphere, *i. e.*, whether vessels are in sight of each other or not.

3. Steering Rules:

(*a*) Sailing vessels meeting, crossing, overtaken or being overtaken by each other.

(*b*) Steamers meeting, crossing, overtaken or being overtaken by each other. We consider that the present rules for steamers are excellent and simple, and would recommend them to remain as they are, but their wording should be freed from all ambiguity. Those for sailing vessels are complicated, and though we have little or nothing to do with the management of sailing vessels, we see no reason why the present steamer rules should not be adopted for their use. It would be a great advantage to have the same rules for both, so that officers or pilots who might go from one class of vessels to the other would have no confusion in their minds.

(*c*) Sailing vessels meeting, crossing, overtaking or being overtaken by steamers.

(*d*) Steamers meeting, crossing, overtaking or being overtaken by sailing vessels.

It is a mooted question whether sailing vessels shall continue to have the right of way, or only at certain times, or not at all. It is certainly as easy for them to give way as it is for a long tow, and also as easy for a schooner, for instance, to manœuvre as for a large steamer. In a narrow channel a long steamer can often not steer, when a sailing vessel could tack easily. We would invite the serious consideration on this most important matter by the Conference, and, on the whole, would throw our influence in the direction of *not* giving the sailing vessel the right of way, and specially not in narrow channels.

In this connection we would also invite the attention of the Conference to steamers towing ahead of long tows through narrow channels with smooth water, Hell Gate for instance. Such tows are not manageable, and our steamers have to give way at imminent risk to themselves. We would recommend that in such waters vessels be obliged to tow alongside.

(*e*) Special rules for channels and tide-ways where no local rules exist.—It would be best to frame the rules so that special rules should not be necessary, unless it is also necessary to take a local pilot.

(*f*) Conflict of international and local rules.—The international rules and local rules should be the same.

(*g*) Uniform system of commands to the helm.—Uniform commands to the helm should be adopted, by all means. The first step towards accomplishing this would be to have the steering wheels of all vessels constructed so as to turn in the same way to produce same change in direction of course. The wheels of our steamers turn in the opposite direction from those of sea-going vessels. Helmsmen going from one class of vessel to another, though taught the difference, are apt to become confused at critical moments.

We would venture to suggest that, at the present day, there seems to be no reason why the word of command should not be the same, as both the ship's head and wheel are to go. For instance, the word "Starboard" should mean put the wheel over to starboard, to make the ship's head go to starboard. This seems to be the most logical, and there seems to be only one great objection, and that is, that the present generation of seamen will have to unlearn the habit of a lifetime. And this objection always exists to any change from old to new.

We would also call your attention to the difference in the compass card of different nations. For instance, the French and English compass are different;

for instance, NE¼E in English has a very different meaning from NE¼E in French, the latter meaning NE by E in English. This we think should be changed.

(*h*) Speed of vessels in thick weather.—We think that "fast" speed is the best in thick weather in open water, provided that vessels will stop or slow immediately on hearing another vessel's fog signal, and will remain so until danger of collision is past.

We give the following reasons: The vessel is less liable to be drifted by currents and tides, therefore more sure of her position, and less apt to drift into the course of a vessel coming from an opposite direction, where vessels follow regular lanes. She will get through a fog bank more quickly, and thus lessen time in which she is liable to collision. She will be under better command of helm. The minimum speed at which large steamers are under control is so great that the effect of collisions is nearly as disastrous as at full speed. When going at a slow speed, a good head of steam must be kept to give an effective back-turn of the engine, and this frequently causes the blowing off of steam, which (unless vessels are fitted with mufflers) will prevent other vessels' signals from being heard.

The fast speed is also most in accordance with the wishes of the public. A steamship line that would habitually deliver passengers, mails, and freight later than any competing line, from no matter what cause, would probably lose the greater part of its business.

In narrow channels we would recommend that vessels should go slow or anchor.

General Division 2.

(*c*) Discipline of crew.—We would here suggest that it be made obligatory for all vessels to carry a bow lookout.

General Division 6.

(*a*) Uniform system of examination for the different grades.—We are of the opinion that it would be a safeguard against loss of life, etc., if the captains, pilots, and engineers of pleasure boats, yachts, steam, and naphtha launches were required to have certificates of efficiency.

General Division 11.

Under this general division we would call the attention of the Conference to the present indiscriminate use of electric lights on wharves, bridges, in cities and parks. We would strongly urge that some measures be taken that any such lights which may interfere with the navigation of adjacent waters be shaded towards such waters.

At present they blind the pilots, interfere with range lights, and mislead greatly in judging distances.

The electric lights on the Brooklyn bridge are a constant source of danger to our steamers. Underneath the bridge it looks like a black wall to the pilots, who are blinded from the glare above, and they cannot distinguish anything. In fact, these lights have about the same effect that the high electric lights at Hell Gate had. That these were a failure was conceded by the U. S. Light-house Board, which had these lights and tower removed.

In conclusion we would state that in framing the new rules all ambiguity in wording them should be carefully avoided. We would also again call attention that simplicity in all rules is of the utmost necessity. They have to be applied at a moment's notice by men of different grades of intelligence, and they should be able to do so without consulting printed regulations or without having to search in their minds for a proper solution. With this view we have refrained from recommending more elaborate systems of lights, fog signals, or code of course and steering signals.

Respectfully,

(Signed) J. W. Miller, *President P. & S. S. Co.*

THE BOMBARDMENT OF UNFORTIFIED, UNRESISTING CITIES.

[Reprinted from the *United Services Gazette.*]

The capture of the Scotch and the bombardment of the English ports, described in our issue of the 31st ult., has again opened up the question whether, in time of war, an unfortified, unresisting city may be bombarded. As the views expressed on this point which have already appeared have been rather contradictory, we refer our readers to an essay by Captain W. T. Sampson, U. S. N., on this topic. He says:

"Those writers on international law who mention the subject lay it down as an acknowledged rule that an unresisting city may not be bombarded. In this matter it is certain that a broad distinction exists, which has not been recognized by writers upon this subject, between the bombardment by an army and a bombardment by a naval force. In the case of an advancing army, it appears most reasonable that it should not bombard a city which offers no resistance, for the army has only to take possession. To bombard under such circumstances would be not only useless, but inhuman: all right-minded people justly condemn it.

"The case is quite different, however, when it is a question of the bombardment of an unresisting city by a naval force; it being understood that resistance would be offered if the naval force should land to take possession. The naval force has the power, as had the army, to inflict injury upon the city, and compel compliance with its demands, but in a different way; and this difference in the form of the force involves a modification of the international rule when applied to bombardment by a naval force."

Upon this point Calvo, a French authority on the law of nations, says: "In no case, under no pretext, is it permitted to bombard an open unfortified city which is not defended by military. To act against such places as the necessities of war authorize to be done against fortresses is to violate all the laws of nations, and to place one's self outside the law of those nations which march at the head of civilization."

"Among the modern cases of this kind which have most awakened public attention may be cited the bombardment of Valparaiso in 1866 by the Spanish squadron, under the command of Admiral Mendez Nunez, which constitutes a deplorable precedent of the application of force as a means of resolving an international question."

"Further upon this subject the same author cites several cases where the attack upon fortified cities was directed upon the fortifications and other defenses, and not upon the city itself, and commends this mode of proceeding as causing less bloodshed. This is, however, questionable and in strong contrast to the business methods inaugurated by Farragut, who passed the fortifications and brought the cities directly under the guns of his fleet. In these cases it cannot be said that the bloodshed was increased."

"The manœuvres of the British fleet during the summer of 1888 led to a very animated discussion, both in the press and in Parliament, upon the question of bombarding undefended cities. All naval and military authorities agreed that it was a kind of warfare likely to ensue in case of hostilities, and that it should be prepared for; while others declared that the rules of civilized warfare forbade such bombardment, and some even went so far as to declare such cities as Greenock would require no defenses, that they would not be molested by any probable enemy. Unfortunately, it cannot be assumed that such opinions were not, to some extent at least, biased by political views. Those in England who think that the navy should be increased took one view, while those opposed to any material increase in the naval force, whether from economical reasons or from opposition to the Government, were led to adopt the view that would require the least preparations for defense."

"One English authority on international law quotes the rules laid down by the military delegates of all European states to the Brussels Conference in 1874, and says that, with the necessary changes in wording, these rules apply to the operations of naval forces against places on land."

The rules that interest us at this time are as follows:

"Art. 15.—Fortified places are alone liable to be besieged. Towns, agglomerations of houses, or villages, which are open or undefended, cannot be attacked or bombarded."

"Art. 16.—But if a town, etc., be defended, the commander of the attacking forces should, before commencing a bombardment, and except in the case of a surprise, do all in his power to warn the authorities."

"As before explained, the rule laid down in Art. 15 is for land forces, and requires material modification before it can be made applicable to a naval force. It is more than likely that the commanding officers will receive specific instructions covering all doubtful cases. The Spanish admiral was so instructed in the case of Valparaiso."

"A city may be defended by armed men only, and consequently be totally unprepared to resist a naval attack; or it may even be fortified to prevent the approach and landing of a naval force, and yet be exposed to destruction by bombardment. No restriction can be placed upon a naval force in either case to prevent bombardment. If such a city refuses to comply with any reasonable—even though exorbitant—demands made upon it, it lays itself liable to bombardment by an enemy having the power to inflict such punishment. On the other hand, it may be safely stated, as a rule, that a naval force intending to bombard a city must give ample warning of its intention, and, if anticipating the approach of succor, must abandon its intention rather than attack without such warning as will permit the escape of women and children. Even should the object of the bombardment be to destroy military or naval depots, it cannot be done without warning, if the lives of non-combatants would be endangered thereby. A notification of intention to bombard should be given only when the naval force is present. It should not be considered proper warning should an enemy telegraph along the coast or to any particular city that it would be bombarded on a specified date."

"Many rules of international law are deliberately violated when it appears to advance the interests of the violator, and there is the necessary power to brave the consequences. It is for this reason that the protection offered by many of the wise and humane rules of international usage are not to be relied upon.

"But this rule, that a city shall not be bombarded without due notice which will permit women and children to be removed beyond possible injury, is a rule no civilized nation would venture to disregard."

"During the manœuvres of the British squadron in 1888, the Irish squadron eluded the blockade of their English enemies, and engaged in a raid upon the English coast, bombarding Greenock, Liverpool, and other unprotected cities. Greenock harbor was entered by a single vessel one Sunday morning and bombarded immediately, without any communication with the shore, and while the people were at divine service. This does not represent actual warfare, because no commander would bombard an open city without first making a demand for a ransom or the fulfilment of any conditions he might see fit to impose. No impossible demand should be made, with the alternative of bombardment in case of refusal. Reasonable time must be granted for a reply, and, in case of refusal, further delay must be granted to permit non-combatants to leave the city. A large sum of money, for example, cannot be produced at a moment's notice, and such transactions must be conducted upon a strictly cash basis. The citizens would doubtless request a modification of the demands, all of which negotiations would require time. This could not be refused by the commander, except in cases of extreme necessity involving the safety of his ship, and even then he would have to face the execrations of the whole world for his inhumanity. In any case, more time would be consumed than ten hours, which was permitted by the English rules."

"We shall see that this has a very important bearing upon the naval defense of a city. The time element that the rule involves furnishes a great advantage to the defenders. The modern practice regarding bombardment of unfortified cities, as in the case of Valparaiso, is directly opposed to the international rule against it. At the same time, the popular conviction of what would take place in event of a foreign war is in harmony with the views expressed above."

"If further argument was necessary to show that an unfortified city may be bombarded by a naval force, it may be found in the statement that if bombardment is not permitted under such circumstances, then complete protection is to be had by non-resistance. An unfortified city that offers no resistance to a naval force would be exempt from molestation, because the naval force, when landed, would be too insignificant to contend with the land force that would then be developed to oppose it. When a fleet has made a demand for a ransom upon a fortified city and the ransom has been refused, the fleet cannot be expected to abandon its position of advantage, its power as a fleet, and land its men and attempt to take by a landing party what was refused to the fleet. If such a construction could be put upon the general rule that unfortified cities may not be bombarded, then it would become absurd, and in coast defense naval supremacy would have no significance."

In examining the different accounts of the raids carried out by the ships of A and B fleets during the late naval manœuvres, we cannot fail to see that, judged by the opinions given above, the performance of the raiding vessels, as regards the time taken, was different from what would be expected in actual warfare.

But enough was done to show that—

1. Unfortified, unresisting cities must expect to be bombarded unless they cash up pretty sharp.

2. The telegraph system failed to give warning in time for the defending force to send succor.

3. Floating defenses, unless very powerful, are of no account.

4. Our military defenses at such places as Aberdeen and other coast towns require strengthening considerably. It is very evident, if we had to fight active and energetic enemies, that, long before their fleet could be destroyed, these military defenses would be brought into play.

5. The torpedo-boats have to score another failure in their powers of offense.

The advantage in speed and size our powerful new battle-ships will have if acting against slightly fortified towns was illustrated by the feats accomplished by the Anson, who distanced all pursuers and always turned up where least expected.

TORPEDO-BOATS FOR THE BRITISH GOVERNMENT.

[Reprinted from the *United Services Gazette.*]

An interesting and very successful trial was on Saturday last made of two of the second-class and one of the first-class torpedo-boats now being built by Messrs. Yarrow & Co., of Poplar. We were much struck by the general handiness, and observed many marked improvements on all previous types.

The firm have on the point of completion ten of the second-class boats for the Admiralty. These are modifications of "No. 50," which was constructed two years ago, and which was also the result of competitive designs submitted to the Admiralty authorities. They are 60 feet in length by 9 feet 3 inches beam, which secures them very fine seagoing qualities. These boats have a guaranteed speed of 16 knots during a run of two hours, carrying four tons. They may be considered as the standard type of second-class boat to be

adopted in future in the British Navy. They are to serve as tenders to our large ironclads, and not only to be used as torpedo-boats, but also for the general service of the ships to which they are attached. The lifting weight averages about twelve tons. They are entirely decked from end to end, which is essential to ensure thorough seagoing qualities; the machinery, of the triple expansion type, is capable of indicating about 200 horse-power. There are small cabins both forward and aft, but in a boat of this size much accommodation cannot be expected. As previously stated, this order was given to Messrs. Yarrow & Co. in consideration of the success of "No. 50," built by them, which has been considered, from actual service, to be a great improvement on the old-fashioned long and narrow second-class torpedo-boats which were previously adopted in the service. As a matter of fact, the present boats, with their far greater beam, actually have a speed of fully half a knot more than those that were formerly constructed, and which were really not safe at sea in rough weather. These second-class boats are built throughout of steel, which is the only material at all suitable for craft of this description, as a wooden structure, if decked in completely, which is essential to make it thoroughly seaworthy, would deteriorate rapidly in consequence of the heat radiated from the boiler.

Last year proposals were invited by the Admiralty authorities for six first-class torpedo-boats, which it was intended to add to the navy during the present year. The designs submitted by Messrs. Yarrow & Co. were those to which preference was given, partly in consequence of their guaranteeing a higher speed than any other firm. These boats are, as regards all leading particulars, similar to "No. 79," a sample boat, constructed three years since by the above firm, and which gave specially good results, on account of her excellent speed, combined with exceptional manœuvring powers. The official trial of "No. 79" was fully reported in the press at the time it took place. As is well known, she has become the favorite torpedo-boat in Her Majesty's Navy, and it will be remembered by our readers that this one was selected to be placed under the command of Prince George of Wales during the naval review and recent manœuvres.

The new boats, which embody all the latest improvements, are 130 feet in length by 13 feet 6 inches beam. They are constructed of galvanized steel, and propelled by triple expansion engines indicating about 1150 horse-power. All six boats have now been tested officially by the Admiralty authorities, the trial speed consisting of a run of three hours' duration, without stoppage of any kind, carrying a load of 20 tons; and the speeds attained have varied from 22½ to 23 knots, the actual speeds being 22.53, 22.57, 22.64, 22.62, 22.59, 23.03, from which it will be seen how remarkably alike the results in all the boats have proved to be.

In comparing these boats with those constructed during the last Russian scare, four years since, it will be of interest to note that the former ones were stipulated, by the authorities then in power, to have a speed of nineteen knots during two hours, carrying a load of ten tons, whilst the present boats actually give from three and one-half to four knots more during a run of three hours, with ten tons greater load. These results represent the rapid advance which has been made in torpedo-boat construction in this country during the last three years. The trials of these boats show that an equal advance has been made as regards steering efficiency and rapidity of manœuvring, which is of almost equal importance to speed.

The forward part of the boat, extending from the bow to the conning tower, is devoted to the accommodation of the crew, and immediately aft of this compartment is a small space containing galley, electric-light plant, and stores. Aft of this is placed the boiler, which is of the locomotive type, but of exceptional size and power, so as to avoid any straining, which recent experience, both in the British and foreign navies, has shown to be so detrimental to the durability and reliability of the boiler, to enable steam to be maintained by

comparatively untrained men. We believe that a locomotive boiler, if properly designed and constructed of the best materials and workmanship, should be a thoroughly reliable, and probably the most advantageous steam generator, and in all those torpedo-boats constructed by Messrs. Yarrow & Co., there has never, as far as we are aware, occurred any accident, although hundreds of these vessels are now afloat and in constant service. The great secret of construction to make a boiler reliable seems to be to design it so that the various parts can accommodate themselves, without strain, to meet the changes of form due to expansion and contraction, owing to variations in the rate of combustion and of pressure. If this main principle is kept always in view in the design, we are fully confident that there should be none of the troubles frequently experienced in working boilers under forced draft, which is mainly due to the rigidity of their construction; and under those circumstances, when any part requires to change its form, however small, owing to the expansion and contraction due to changes of temperature, an overwhelming force is involved, and something must in consequence give way. Another special feature in these new boats, and one of great importance to fighting ships, is the adoption of Yarrow's system of enclosing the furnace, or fire-box, of the boiler in a complete water-tight casing. In this system all the air which is required for the purpose of combustion has to pass over the casing and then downward to the furnace. The effect of this is to prevent the extinction of the fire, should a sudden inrush of water find its way into the stokehole or boiler compartment.

The importance of securing immunity from this will be self-evident when the probability of damage to the thin steel plates of the hull through shot or collision is borne in mind. It has been found that when the boiler compartment is filled with water the steaming power of the boat is sufficiently maintained to enable it to run fully fifty miles without a fireman entering the stokehole. Aft of the boiler compartment is the engine room, in which are placed triple expansion engines capable of indicating about 1150 horse-power. Within the engine room, in addition to the propelling machinery, there are two engines for compressing air for the use of the torpedoes; an engine for driving the ventilator, which forces the air under pressure to the furnaces; also an engine for producing a current of water through the surface condenser, and an engine for steering the boat. Further aft we come to a cabin compartment, in which is supplied sleeping accommodations for two engineers; also the magazine for the supply of ammunition for the machine guns. Aft of this we come to a neatly fitted up cabin for the officers, and further aft a pantry for the officers' use. The armament consists of one torpedo-gun for direct ahead fire, placed forward below the turtle deck and secured into the stem of the boat. Near the stern is provided a turntable, on which are placed two torpedo-guns for side fire. These two guns are placed at an angle of five degrees with one another, arranged on Yarrow's patent system; by which means, if the two torpedoes are fired simultaneously, by taking slightly divergent courses, they cover a much larger area, and consequently ensure much more certainty of hitting the vessel aimed at, on the same principle that in firing at a bird on the wing a number of small shots are adopted, which disperse, in preference to firing one shot only. This system of arranging the torpedo-guns is now becoming largely adopted, especially for side fire, where the difficulty of accurate aim is enhanced. The machine-gun armament consists of three 3-pounder quick-firing guns, one amidships and one on each beam, in echelon. Steering gear is fitted at two points, one within the conning tower (which would mainly be used in time of war) and aft, in front of which a movable brass shield is placed for the protection of the steersman.

As regards the manœuvring power of these boats, it may be mentioned that they can turn to port or starboard within a circle the radius of which is only a trifle in excess of the length of the boat, and this result is obtained by means of only one rudder of the simplest construction. The times occupied in turning circles when running at full speed averaged seventy-five seconds. The rudder

is designed in such a manner that when hard over it counteracts the natural heel of the boat, thus maintaining a steady platform, and avoiding at the same time the risk of capsizing, to which torpedo-boats, both in the French and Danish navies, have lately shown themselves liable. The trials of these boats took place below Gravesend, and the above speeds were obtained during runs over the measured mile at Lower Hope, at intervals determined by the Admiralty authorities during the run of three hours, and therefore represent the mean speed of the three hours' run. There is one point in the construction of these boats which should be noted, viz., the bulkheads are throughout intact, there being no opening or door of any kind in them, and which experience has shown to be so often open at the very time when the subdivision of the hull is most needed.

In addition to sixteeen boats which Messrs. Yarrow & Co. are now on the point of completing for the British Government, they have also in hand fourteen for foreign governments.

CAST-IRON MORTAR.

[Reprinted from the *Army and Navy Register*.]

The 12-inch cast-iron mortar, which was submitted to the Ordnance Department by Wm. P. Hunt, Esq., of Boston, for testing under the terms of the act of Congress of last winter, has gone to pieces at Sandy Hook, and it is possible that we may hear no more of cast iron as a material for heavy ordnance in this country. The mortar broke up on the twentieth round with a charge of only 55 pounds of powder. It had been fired round for round, under the same conditions as the steel-hooped mortar, which has been fired over 200 times, and the record of the pressure gauges on the exploding charge were not excessive, being less than 30,000. The mortar burst on the 3d inst., Mr. Hunt being present at the time.

BOOK NOTICES.

THE WAR DEPARTMENT AT THE CENTENNIAL EXPOSITION, CINCINNATI, OHIO, 1888.

This is a complete catalogue of the War Department exhibits, arranged by Capt. A. H. Russell, U. S. A. The exhibits are so arranged as to present a historical series, outlining the development of firearms from the earliest period. Besides ordnance stores, there were articles from Quartermaster and Signal Departments. The clear and concise description of each article adds greatly to the value of the catalogue.

THE DEVELOPMENT OF GREAT CIRCLE SAILING. By G. W. Littlehales, U. S. Hydrographic Office.

The preface to this work, signed by the Hydrographer, shows its value: "This publication has for its object the furtherance of the effort of the Bureau of Navigation of the Navy Department to keep pace with the progress of the nautical sciences. It consists of an exposition of graphical and analytical methods embodying cardinal principles relating to the great circle, as applied to navigation, and gives publicity for the first time to several of the most convenient and useful methods yet devised.

"The actual state of the science of great circle sailing is here presented so as to give a clear conception of each method, and to furnish references where more extended information can be found.

"(Signed) GEORGE L. DYER."

CATALOGUE OF STARS OBSERVED AT THE UNITED STATES NAVAL OBSERVATORY, 1845–77. By Prof. M. Yarnall, U. S. N. Third edition revised by Professor Edgar Frisby, U. S. N.

The corrected edition of the Star Catalogue will be of value and interest to such naval officers as are acquainted with the use of the zenith telescope, as it is a useful addition to the B. A. Catalogue. The original edition was mainly composed of stars used in the army surveys for observations for latitude with the zenith telescope. R. W.

BIBLIOGRAPHIC NOTES.

AMERICAN CHEMICAL JOURNAL.

VOLUME XI, No. 4, APRIL, 1889. Morse and White show that oxides of zinc or cadmium are dissociated in zinc or cadmium vapor respectively. Smith and Frankel give method for the electrolytic separation of mercury from copper. Drown and Martin apply the Kjeldahl method to determine nitrogen in waters. E. H. Keiser reviews recent syntheses in the sugar series.

No. 5, MAY. Ira Remsen discusses the structure of "double haloid salts." Morse and White show that the sulphides of zinc and cadmium are dissociated in the vapors of their respective metals. Smith and Frankel give method for electrolytic separation of cadmium from zinc. Notes: Allotropic forms of silver, by Carey Lea; Determination of iron in presence of hydrochloric acid by means of permanganate of potassium, by C. Reinhardt.

No. 6, SEPTEMBER. E. H. Keiser redetermines the atomic weight of palladium, finding the figures 106.35. C. R. S.

ANNALEN D. HYDROGRAPHIE U. MARITIMEN METEOROLOGIE.

17TH ANNUAL SERIES, No. 6. Report of experiments made at the German Observatory to establish the conduct of marine chronometers when placed on movable foundations. Report on Santos, by Capt. Fr. Niejahr, Commander of the German bark J. F. Pust. Extracts from the log of Captain Reesing, of the German steamer Thuringia. Sailing directions for the Congo from its mouth to Boma. Description of the east coast of Sipora or Sikabou, west coast of Sumatra. The sudden fall of the barometer in Middle Europe.

JAN. 31–FEB. 1, 1889. Quarterly weather review of the German Observatory for summer of 1885. Minor notices: Sandwich Harbor (Port D'Ilheo), west coast of Africa; Remarks on Walfish Bay; Voyage from Walfish Bay to Cape Town; Weather and currents near Barbadoes.

No. 7. General index of the Annual Series from 1873 to 1888.

No. 8. Tides on the coasts of the Netherlands. Normanton, Gulf of Carpentaria, Australia—report of Captain F. Rumpf, of the German bark Balcarry. Reports on voyages in the East India Archipelago, by Capt. L. A. Meyer, of the ship Kriemhild. Steamer

routes between Aden and the Netherland East India possessions. Report of the twelfth competitive examination of marine chronometers, held at the German Observatory during the winter 1888–1889. Quarterly weather review of the German Observatory, summer 1885 (conclusion). Minor notices: Extraordinary heavenly phenomena; New ship channel to Melbourne; Harbor of Fremantle, west coast of Australia; Humboldt Bay; Bottle post; Observations of earthquakes at the Imperial Observatory at Wilhelmshaven.

E. H. C. L.

BOLETIM DO CLUB NAVAL.

FEBRUARY to JUNE, 1889. Reorganization of the fleet. Theory of the rudder. Study on the construction of boats peculiar to Brazil. Repeating rifles. Notices to mariners. The naval school. General considerations on steam engines. Study on naval hygiene.

J. B. B.

BOLETIN DEL CENTRO NAVAL.

MARCH, 1889. The Nicaragua Canal. Naval wars in the future.

APRIL. Naval wars in the future. A. C. B.

BULLETIN OF THE AMERICAN GEOGRAPHICAL SOCIETY.

VOLUME XXI, No. 3, SEPTEMBER 30, 1889. A look at Algeria and Tunis. The Portuguese in the track of Columbus. Geographical notes.

DEUTSCHE HEERES ZEITUNG.

No. 52. Paper torpedoes.

Experiments made in Germany with torpedoes made of paper, loaded with a charge of 25 pounds of dynamite, propelled and fired by electricity. Very satisfactory results are said to have been obtained with these new torpedoes, which possess great solidity and elasticity against shock.

Naval manœuvres at Zoppot (Germany).

Consisting of landing manœuvres with a large force and artillery exercise at night with electric targets.

No. 54. Electricity on submarine boats. Description of the French submarine boat Gymnote: experiments at Toulon. Russia: launching of the ironclad Emperor Nicolas.

No. 55. Krupp's trials of a new powder.

Since the publication of Krupp's last report, No. 73, October, 1888 (mentioned in No. 49, Vol. XV, 2, of the Proceedings), new trials with the prismatic powder manufactured by the United Rheinisch-Westphalian Powder Mills have developed a still further increase of efficiency.

No. 58. The Satean Poisson of Mr. Gonbet (France). Torpedo trials in the U. S.

Nos. 59, 60. The French naval manœuvres. Accidents to torpedo-boats. Russia: organization of torpedo divisions.

Nos. 65, 66. Trials with explosives. Launching of the German coast defense armor-clad vessel Siegfried at Kiel (August 10, 1889). Changes in the foreign stations of German vessels. Contribution to the English "gun question." Russian naval manœuvres.

Nos. 67, 68. The French torpedo-boats. Shipbuilding in England. Numerical strength of the fleets of Europe at present and in 1894.

No. 70. Use of electricity for coast defense in the United States.

Nos. 72–74. The pneumatic dynamite gun and its use for coast defense and at sea (lecture by Captain Zalinski before the Royal United Service Institution). Return and reception at Kiel of the crews of the German vessels wrecked at Samoa. Modification of French torpedo-boats. Report on the trials of torpedo-boats in Spain. H. M.

JOURNAL OF THE AMERICAN SOCIETY OF NAVAL ENGINEERS.

VOLUME I, NO. 3, AUGUST, 1889. The manufacture of steel castings. A brief account of the method of working spirally welded tubing. Some lessons from Samoa.

In this paper Chief Engineer McKean mentions among the important lessons to be learned from this disaster, 1st, the necessity for increased power, as, if our ships had power approaching that of the Calliope, some of them at least might have "clawed off"; 2d, protection to propellers; 3d, greater security for the smoke-pipe; 4th, the great advantage of having the bilge pumps and strainers perfectly accessible; 5th, the advisability of having one rocket apparatus, or life-saving gun, capable of being moved to any part of the spar deck, and always ready for use; 6th, with water rising rapidly in the holds, in many cases provisions could not be reached. It would not be impossible to have some concentrated ration in small bulk stowed in lockers fore and aft; and in case of abandoning ship from any cause, this supply could be available for the boats; 7th, exercising the men in diving with the aid of suits or other apparatus. The armor would often be of great service in clearing propellers, closing orifices temporarily for repairs, examining copper, etc., etc.; 8th, the position of the hawse pipe will no doubt receive due attention in our new ships, though in them the water-tight bulkheads should at least prevent the fires from being extinguished.

Phenomena attending ship propulsion.

A discussion on Chief Engineer Isherwood's article on this subject.

Report of the performance of the S. S. Meteor. Acts of Congress applying to new vessels. Space occupied by the machinery of some of the new cruisers. Ships and steam trials. English naval manœuvres. Combined indicator cards of the U. S. S. Yorktown.

J. K. B.

JOURNAL OF THE ASSOCIATION OF ENGINEERING SOCIETIES.

JULY, 1889. Duty trials of pumping engines, by Geo. H. Barrus.

AUGUST. Steam plants for electric service, by H. Bryan. A system of marking patterns, by A. J. Firth.

SEPTEMBER. High-service system of the Boston water works.

F. H. E.

JOURNAL OF THE U. S. CAVALRY ASSOCIATION.

VOLUME II, No. 5. Cavalry war lessons. The pistol versus the sabre for light artillery. Identification of deserters. Letters on cavalry. Marching and camping cavalry and caring for horses in the field. Drill regulations for cavalry, United States Army.

No. 6. A horse's foot. My ride around Baltimore in 1864. Letters on cavalry. New drill regulations for cavalry, United States.

JOURNAL OF THE FRANKLIN INSTITUTE.

AUGUST, 1889. On Koyl's parabolic semaphore.

SEPTEMBER. Aluminium. Harbor bar improvements.

OCTOBER. Experiments on the efficiency of pumps. Harbor bar improvements. Mechanical progress. The past and present contrasted.

NOVEMBER. The aneroid barometer.

JOURNAL OF THE MILITARY SERVICE INSTITUTION.

VOLUME X, No. 39. An American war college. Mobilization. More about cavalry gaits. New course of instruction, Fort Monroe. The infantry in the field.

No. 40. Puget Sound; a sketch of its defenses. The development and use of hasty intrenchments for infantry. Desertion in the United States Army. Some thoughts with reference to the organization of our artillery. The uniform of the West Point cadet.

No. 41. Personal identity in the recognition of deserters. An interoceanic canal. Use of railroads in war. Military training of the regular army. Revision of our infantry tactics. R. W.

MECHANICS.

MAY, 1889. Notes on steel inspection of structure and boiler material. Wind pressure. The propellers of the Baltimore. An investigation of experiments made on a centrifugal blower. The Riehle adjustable transverse elastic limit indicator.

JUNE. The American Society of Mechanical Engineers.

A special report of the meeting of this society, with an abstract of papers on the comparative cost of steam and water power; notes on the comparative loss by friction in a transmitting dynamometer under different loads and speeds; steam consumption of engines at various speeds; standards; notes on the steam turbine; the tractive force of leather belts; longitudinal riveted joints of boiler shells; the use of petroleum in steam boilers; the piping of steel ingots; some properties of vapors and vapor engines; cylinder ratios of triple expansion engines and the performance of a 35-ton refrigerating machine of the ammonia absorption type.

JULY. The Thorneycroft boiler. The application of photography to surveying. Practical hints for gearing. An improved engine indicator.

SEPTEMBER. Economy in the use of belting. Water gas in steel furnaces. Technical education. Testing cast iron. Corrosion and pitting in marine boilers. J. K. B.

MITTHEILUNGEN AUS DEM GEBIETE DES SEEWESENS.

VOLUME XVII, NOS. 7 AND 8. England and the Declaration of Paris. Launching torpedoes by means of powder in the French navy. Nautical science during the ages of the greatest discoveries. Dangers in the management of engines on board of vessels. Advance in photogrammetrie. Ballistic photographic experiments in Pola and Meppen, by Prof. E. Mach and P. Salcher. Armor of battle-ships, by Sir N. Barnaby. Wreck of the German men-of-war in Apia. Apparatus to ensure a constant and steady platform for guns. New paint for bottoms of iron and steel ships. Henderson's folding life-boat. New method for raising the armor-clad Sultan. Screw-propellers for light-draught vessels. New vessels for the Chilean navy. Greek armor-clad Hydra. Launch of the torpedo cruiser Planet. Arduis' optical-electrical signal apparatus for vessels. Electric engine telegraph. English torpedo supply vessel Vulcan. Legé torpedo. New type of American torpedo-boats. New air-compressing pump for torpedo purposes. Paper torpedoes. Torpedo-boat dock for the French navy. Official programme of the International Maritime Conference at Washington. Remarks on hurricanes. Cleaning of chronometers. The 2000-ton steel cruisers of the United States navy. Competition for plans of a Russian armor-clad. Arming of English vessels. Names of English men-of-war in process of construction. Armor of the Italian men-of-war in process of construction. Branch of the firm Krupp in Italy. Quick passage across the Atlantic. Italian cruiser Piemonte. Model of ocean currents. Literature. Bibliography.

No. 9. Electric lighting, with special reference to its application on shipboard. Boilers. Movement indicator. Precautions against the effect of electric light on ships' compasses. Coaling at sea. Trial of a Brennan torpedo. Scott's electric log. Trials with propellers in England. Trial trips of English men-of-war. Four-hour full power run of the English Mediterranean squadron. New torpedo scouts for the French navy. Laying the keel of the English protected cruiser Pallas. Construction of three English cruisers of the Medea type. Rapid-firing cannon of the Skoda pattern. New English torpedo-boats. Torpedo-boats for the Argentine Republic. New French men-of-war. Literature. E. H. C. L.

NORSK TIDSSKRIFT FOR SOVAESEN.

SEVENTH ANNUAL SERIES, No. 6. How can collisions at sea be avoided, etc. Remarks on Capt. O. Hansen prize essay: Necessary strength of army and navy, and armament required for coast defenses of Norway and Sweden, by Col. Giertsen (conclusion).

Future naval wars. New electric boat. Protection and armor of English vessel. Inland navigation of Russia. The Formidable. Capsizing of a French torpedo-boat. John Ericson. Neutralization of the Banks of Newfoundland. Spanish submarine boat.

E. H. C. L.

PROCEEDINGS OF THE INSTITUTION OF CIVIL ENGINEERS, LONDON.

VOL. XCVI. Some canal, river, and other works in France, Belgium, and Germany, by L. F. Vernon-Harcourt. Economy trials in a non-condensing steam engine: simple, compound, and triple, by Peter W. Willans. Selected paper No. 2394: Tests of a Westinghouse engine, by S. Alley. Foreign abstracts: Excavations for the locks on the Panama Canal, by Max de Nansouty (*Le Genie Civil*). Corinth Ship Canal, by Armand Saint Yves (*Annales des Ponts et Chaussées*, Vol. XVI). The basic open-hearth process at Gratz, by F. Moro (*Stahl und Eisen*, 1889). On nitrogen in Bessemer and open-hearth steel, by H. Tholander (*Jernkontorets Annaler*, 1888). Regulators for electrical distribution, by George Marier (*Annales des Mines*, 1888). On the nature of the welding of iron and nickel, by T. Fleitman (*Stahl und Eisen*, 1889).

VOL. XCVII. Alternate current machinery, by G. Kapp. The district distribution of steam in the United States, by C. E. Emery, Ph. D. Selected papers: On steamers for winter navigation and ice-breaking, by R. Runeberg. West of India Portuguese Railway and harbor works, by E. E. Sawyer. On the new steel dock gates of Limerick floating dock, by W. J. Hall, B. E. Perforated cake powder for ordnance, by G. Quick (abstract). The removal of rock under water without explosives, by F. Lobnitz. Foreign abstracts: Automatic maximum and minimum tide register, by C. T. van Sluys (*Tijdschrift van het Koninklijk Instituut van Ingenieurs*, 1888–89). The permeability of Portland cement mortar and its decomposition by sea water, by L. Durand-Cloye and P. Debray (*Annales des Ponts et Chaussées*). Note on a glass apparatus for rendering visible the effects of condensation and evaporation that take place inside a steam engine cylinder, by B. Donkin, Jr. (*Bulletin de la Société Industrielle de Mulhouse*, 1889). The port of Buenos Ayres (*El Ingeniero Civil*, Buenos Ayres, December 15, 1888). On the industrial and economic value of dynamo-electric machines, by R. Arnoux (*L'Electrician*, 1889). Measurements of the resistance of insulators with varying electro-motive force, by F. Uppenborn (*Centralblatt für Electrotechnik*, Vol. II, 1889). F. H. E.

PROCEEDINGS OF THE INSTITUTION OF MECHANICAL ENGINEERS.

JANUARY, 1889. On the use of petroleum refuse for fuel. Compound locomotives.

MAY. Report of the Research Committee upon steam engine trials. The trial of the S. S. Meteor. J. K. B.

THE RAILROAD AND ENGINEERING JOURNAL.

MAY, 1889. The development of the modern high-power rifled cannon. French armored cruisers.

An account of the latest additions to the French navy, which include armored cruisers of three classes, outline sketches and deck plans.

Experimental guns for the army.

JUNE. United States naval progress.

The plans and specifications of the new vessels, together with an account of the rate at which the vessels now under construction are approaching completion.

The development of high-powered rifled guns. The escape of the Calliope. Hydraulic engine for loading guns.

A description of the mechanism for working the guns on board the Edinburgh and Colossus.

The new English battle-ships.

The principles laid down by the English Admiralty for the design and construction of eight new battle-ships of the first class.

Corrugated tubular fire-boxes for locomotives.

JULY. United States naval progress (a description of the design for the new 2000-ton cruiser). Quadruple-expansion engines of the steamship Singapore. Nickel steel.

In a paper read before the British Iron and Steel Institute, the author stated the result of an examination made into this new alloy of nickel and steel. His experience led him to conclude that the alloy can be made in any good open-hearth furnace, working at a fairly good heat. Its working demands no extraordinary care. No special arrangements are required for casting, the ordinary ladles and moulds being sufficient. The new alloy has an advantage over ordinary steel, because it does not easily corrode. Steels rich in nickel are, in fact, non-corrodible, and those poor in nickel are still much better in this respect than ordinary steel. Alloys up to 5 per cent of nickel can be readily worked in the lathe or planer, but richer alloys are more difficult to work. Poor alloys stand punching very well. The one per cent nickel steel welds fairly well, but richer alloys do not weld easily. In the test of this material, one piece tested gave: breaking strain, 95 tons; elastic limit, 54 tons; extension (in 4 ins.), 9.37 per cent; contraction of area, 49 per cent. Other pieces gave nearly parallel results. The author states that gun-barrels made of nickel steel stood very high tests, and that a 6-inch gun of this metal had been ordered by the English Government.

AUGUST. Sketches and description of the English battle-ship Benbow and the Italian cruiser Piemonte. Hydrography and hydrographic surveys.

OCTOBER. Hydrography. Oil as a metallurgical fuel. Illustrated description of electric light installation for United States cruisers. The development of modern high-powered guns (continued).

J. K. B.

REVUE DU CERCLE MILITAIRE.

JULY 7, 1889. The defense of the Vosges, and mountain warfare. The Danish army on a war footing. The war exhibit at the Paris Exposition (continued).

JULY 14. The ancient marine at the Palais des Beaux-Arts, with cuts in the text. The defense of the Vosges, and mountain warfare, with illustrations (continued). The war exhibit (continued). Military chronicle: Jurisprudence and the messenger pigeons.

JULY 21. Night marches and encounters. The defense of the Vosges, and mountain warfare (end). The war exhibit at the Exposition of 1889 (ended).

JULY 28. The shelter trench (tranchée-abri), with illustrations in the text. French influence beyond the seas. The military exhibit of 1889. Naval manœuvres, etc. The new regulations for infantry manœuvres; Title V, school of regiment.

AUGUST 4. The army recruitment; law of July 15, 1889. The military exhibit of 1889 (continued), with cuts in the text.

AUGUST 11. The fleet versus coast batteries. The army recruitment; law of July 15, 1889. The military exhibit (continued), with cuts.

AUGUST 18. The fleet versus coast batteries (an answer to the preceding article on the same subject). The army recruitment; law of July, 1889.

AUGUST 25. Leading of columns on a march, and the directing compass (military strategy), with illustrations. The pacific conquest of the African interior. The military exhibit, etc.

SEPTEMBER 1. The army corps of six brigades. The supply train. A few words about the instruction of cavalry troops.

SEPTEMBER 8. The development of the torpedo-boat. First succor to the wounded on the battlefield. Military exhibit, Paris Exposition, 1889.

SEPTEMBER 15. The mountain gun. The development of the torpedo-boat. The civic duties of the soldier and the military duties of the citizen. The military exhibit of 1889 (continued).

SEPTEMBER 22. The military oath in the Russian army. The development of the torpedo-boat. The military exhibit (continued).

SEPTEMBER 29. The "Sud-Oranais" campaign against Bon-Amena in 1881; from the diary of a cavalry officer. The flag. The call of the "réservistes" and the territorials. Principles of hygiene. The military exhibit of 1889. Military chronicle: Letter from the United States, etc. J. L.

REVISTA MILITAR DE CHILE.

NOS. 30–35, MARCH to AUGUST, 1889. Comparison between the Krupp and the De Bange systems, by Lieutenant-Colonel Don J. C. Salvo. Experiments made in foreign countries on the reducing of gun-calibers (continued). The Lebel gun, by Captain Cousiño. De Bange artillery, by Lieutenant-Colonel Don J. C. Salvo. The repeating rifle, and the small-caliber rifle, by A. de P. History of powder, by Lieutenant-Colonel Don R. U. O. J. B. B.

REVISTA MARITIMA BRAZILEIRA.

DECEMBER, 1888, to JULY, 1889. Naval apprentice school. Naval jurisprudence. Naval reforms. Institution of a military school in Brazil. Submarine boats. Neutralization of the Suez Canal. On tempests. Article on explosives. Practical school of artillery. The navigation of the coast. Maritime warfare. The Armstrong rapid-fire guns. Account of cruise of the Rèachuelo in 1888–9. The ironclad Piemonte. Meteorological observations. J. B. B.

REVUE MARITIME ET COLONIALE.

JUNE. Scientific mission to Cape Horn; meteorology (ended). Guadeloupe and its dependencies. Notice on the military organization of the expeditionary corps to Massaouah. Notes on the Fourrier dromoscope and its appliance to the behavior of the compass on board the Duquesne. The English navy budget. A history of the French East India Company.

JULY. A history of the French East India Company (ended). Historical notes on the Gavre committee (continued). Legislation for the French possessions of Madagascar.

AUGUST. Historical studies of the military marine of France; the great fleets of Louis XIV. A study of sextants in regard to excentricity. The cohorts of the Legion of Honor. Organization of a practical school of artillery in Portugal.

SEPTEMBER, 1889. Perturbation of the compass on the coasts of Iceland. Historical notice on the commission of Gavre. A Breton privateer in the XV century. Regulations for the Academy of the Italian royal navy at Leghorn. The cohorts of the Legion of Honor. Chronicle. The Teutonic as an auxiliary cruiser. Naval constructions in England. Plans of the new American cruisers. Naval manœuvres in England. The German torpedo-boat of pressed paper. J. L.

RIVISTA MARITTIMA.

MARCH, 1889. The Grenfell sight. Submarine vessels (historical).

APRIL. Acquisition and loss of Cyprus, by Vice-Admiral L. Fincati. Economical speed in ships, by Captain D. Bonamico. Report on the English naval manœuvres of 1888.

MAY. Economical speed in ships (continued). Speed trials of the Lepanto. Project for canal from Rome to the Mediterranean. On sheathing metal bottoms (translation of article in No. 48, Proceedings U. S. Naval Institute).

JUNE. Description (with plates) of the Italian cruiser Piemonte. Economical speed for ships (conclusion). The acoustic faculty in seafaring men. Fog signals, by Doctor F. Santini. Armor for ships, by N. Soliani, Italian navy. On sheathing metal bottoms (conclusion).

JULY and AUGUST. Acquisition and loss of Cyprus (continued). Critical study of the port of Barcelona, with notes on the different Mediterranean ports, by E. S. di Tenlada. Coast defense, by C. A. On the penetrability of armor plates. Notes taken at Krupp's establishment. Speed trials of Italian ironclad Lepanto (conclusion). On the development of modern explosives, by D. G. The Society Islands and the natives of Polynesia, by Dr. Filippo Rho. Latest improvements in Thorneycroft torpedo-boats (translation).

J. B. B.

ROYAL ARTILLERY INSTITUTION.

VOLUME XVII, No. 4. Proposed target for testing uniformity of laying. Plotting board for cross-bearings. The bursting of the 34-cm. gun on board the Amiral Duperré.

No. 5. The trajectory of a projectile for the cubic law of resistance.

No. 6. Internal ballistics. Simple-position finding. The 12-pounder shrapnel and its defects. Coast batteries *vs.* fleets.

ROYAL UNITED SERVICE INSTITUTION.

VOLUME XXXIII, No. 149. Fortifications and fleets. The training of the executive branch of the navy.

No. 150. The tactics of coast defense. The mariner's compass in modern vessels of war. The mechanical coaling of steamers. The pneumatic torpedo-gun; its uses ashore and afloat. The photographing of artillery projectiles travelling through the air at a high velocity.

R. W.

THE SCHOOL OF MINES QUARTERLY.

APRIL, 1889. Western Union time system, by F. R. Bartlett, C. E., and R. P. Miller, C. E. Winding engines, by Herbert W. Hughes, F. G. S.

JULY, 1889. Fuel oil for stationary boilers in New York City, by H. F. J. Porter, M. E.

Committee appointed to consider the best method of establishing international standards for the analysis of iron and steel. British Association for the Advancement of Science, Section B. Committee: Professor Roberts-Austen, F. R. S., Chairman; Sir F. Abel, C. B., F. R. S.; Professor Langley; Edward Riley; G. J. Snelus, F. R. S.; John Spiller; Professor Tilden, F. R. S.; and Thomas Turner, Secretary. *Objects.*—It is proposed that the committee shall co-operate with other similar committees in the more important iron-producing countries, in order to provide standard specimens of iron and steel, the chemical composition of which shall have been carefully determined. The specimens adopted as standards shall be intrusted to some recognized official authority, such as the Standards Department of the Board of Trade, and shall be used for reference in the determination of the accuracy of any proposed method of analysis, or for controlling the results of analyses in any cases of importance which may from time to time arise.

Suggestions.—1. Professor J. W. Langley, of the University of Michigan,

U. S. A., to be requested to superintend the production of the samples; that they be prepared and preserved in accordance with the directions to be furnished by the committee; and that an equal portion of each sample be forwarded to the several secretaries of the respective committees in the United Kingdom, America, France, Germany, and Sweden.

2. The specimens are to be eventually adopted as standards, to be supplied to not more than seven representative chemists of repute in each of the countries above mentioned, who shall be requested to analyze the specimens by any method or methods they may prefer.

3. In the event of the analyses giving results which in the opinion of the committee may be regarded as sufficiently concordant, the means of the analytical results of each of the several constituents to be adopted as representing the composition of the standards. The reports on the analytical results not to be issued before the various analysts to whom the samples have been submitted shall have had an opportunity of examining it. The standards shall hereafter be distinguished only by letters or numbers.

4. The attention of the committee to be for the present confined to four samples of steel, selected as containing as nearly as possible 1.3, 0.8, 0.4 and 0.15 per cent of total carbon respectively. In addition to the determination of the amount of carbon present in each condition, the phosphorus, sulphur, silicon, manganese and chromium also to be determined.

5. 150 kilos of the samples selected for examination as standards to be prepared in all. This would give, after allowing sufficient for the required analyses, quite 5 kilos of each standard for each of the five countries interested, allowing say 10 grams for each applicant who may desire to use the standards. This would permit of 500 appeals to each of the four standards in each country, or at least 10,000 appeals in all.

6. The samples to be analyzed in the United Kingdom by W. Jenkins, Dowlais; Edward Riley, London; J. E. Stead, Middlesbrough; The Royal School of Mines; G. S. Packer, of the Steel Company of Scotland; and two others.

7. The metal of which the samples are to be produced to be cast in small ingots, special care being taken to prevent any irregularity of composition. After the removal of the outer skin, the metal to be cut by a blunt tool in the form of thin shavings, then crushed, sieved, and intimately mixed.

8. The samples thus prepared to be preserved in separate small quantities (say of 30 grams each), which shall be hermetically sealed in glass tubes, so as to prevent oxidation.

9. These preliminary arrangements of the committee to be communicated to the leading technical journals. F. H. E.

THE STEAMSHIP.

JULY, 1889. Marine engine economy. Mechanical refrigeration. Electric lighting. Coal and combustion. The speed of steamships.

AUGUST. Additions to the British navy. American opinion of twin-screw steamers. Combined indicator cards of triple-expansion engines. Experimental aid in the design of high-speed steamships. Thompson's combined circulator and feed-water heater. Electric lighting. Cranks and screw-shafts in the mercantile marine.

SEPTEMBER. The naval review of 1889. Expansion of steam. Illustrations and description of the U. S. S. Baltimore. Drawings and description of the Merton valve gear, with its application to ships of recent design. J. K. B.

TRANSACTIONS OF THE AMERICAN INSTITUTE OF MINING ENGINEERS.

FEBRUARY, 1889. New York meeting. The influence of silicon in cast-iron, by W. J. Keep.

TRANSACTIONS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

MAY, 1889. On flood heights in the Mississippi river, by William Starling.

JUNE. Some experiments on the strength of Bessemer steel bridge compression members, by James G. Dagron.

JULY. American railroad bridges, by Theodore Cooper.

TRANSACTIONS OF THE CANADIAN SOCIETY OF CIVIL ENGINEERS.

VOLUME II, PART II, OCTOBER to DECEMBER, 1889. Inception of electrical science and the evolution of telegraphy, by F. N. Gisborne. A mine pump working under a heavy pressure, by H. S. Poole.

TRANSACTIONS OF THE NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS.

MARCH, 1889, PART I AND II. The danger attending the use of light mineral oils for lubricating air-compressing machinery, by John Morrison. F. H. E.

TRANSACTIONS OF THE NORTHEAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.

VOLUME V. The use of machinery in construction. A new system of shipbuilding to facilitate the application of machine riveting to shell plating. A new wave-motor. The structural strength of cargo steamers. The development of the "well-deck" cargo steamer. Corrosion and pitting in marine boilers. The proper capacity of air pumps.

THE UNITED SERVICE.

VOLUME II, No. 4. The Canadian question. Nautical proverbs and sayings. The Nez Perce War. Old uniforms of the United States service. From bars to stars. The Royal Irish Constabulary.

No. 5. Soldier or granger. The United States Revenue Cutter Service. An incident of Fredericksburg. The mobilization of the fleet. Chronicles of Carter Barracks. The English naval manœuvres. Some military reminiscences of the Rebellion.

No. 6. The evolution of the torpedo-boat. Our view of the army question. The United States Revenue Cutter Service. A fair Georgian. The annual inspection of the National Guard by army officers. A remarkable episode of the late war.

UNITED SERVICES GAZETTE.

JULY 6, 1889. Her Majesty's ship Sultan. Probationary assistant engineers, R. N. The escape of the Calliope. The pneumatic dynamite gun. The Sultan inquiry.

JULY 13. The Sans Pareil. The Warspite. The mobilization of the fleet. Saving life at sea. An English rival port to Delagoa Bay. Controllable torpedoes. A suggestion for the Admiralty.

JULY 20. The naval manœuvres. Ships building. The Royal Naval School. Dock-yard apprentices.

JULY 27. Naval inspection of the squadrons mobilized for the manœuvres. Ships building and to be built. The naval review. The programme of the naval manœuvres. Quick-firing guns—I. The Royal United Service Institution. Naval reviews.

AUGUST 3. The Royal Naval School. The Thames Nautical Training College. The naval review. Quick-firing guns—II. The stoker question.

AUGUST 10. The naval manœuvres. The lords of the Admiralty at Portsmouth. The German Emperor and the Royal Yacht Squadron. Continental systems of coast defense.

AUGUST 17. The naval manœuvres. The Royal United Service Institution.

AUGUST 24. The Naval Annual. The case of Admiral the Earl of Dundonald. The naval manœuvres. Coaling stations. The boiler question.

AUGUST 31. Outline of a scheme for the naval defense of the American coast—I.

This is the first of a series of papers on the lecture of Capt. Sampson, U. S. N., published in No. 49 of these Proceedings.

The medical officers of the army and navy. Navy surgeons. The naval manœuvres. The raising of the Sultan. The lords of the Admiralty at Plymouth. Coaling ship.

SEPTEMBER 7. Outline of a scheme for the naval defense of the American coast—II. Lessons to be learned from the naval manœuvres of 1889.

SEPTEMBER 14. Launch of war-ships. Sailors' rations.

SEPTEMBER 17. The bombardment of unfortified, unresisting cities. Torpedo-boats for the British Government. The Engine-room Department, Royal Navy.

SEPTEMBER 28. Outline of a scheme for the naval defense of the American coast—III. The loss of the Lily. The Engine-room Department, Royal Navy.

OCTOBER 5. Lord Armstrong on quick-firing guns and smokeless powder. Smokeless powder.

OCTOBER 12. The late naval manœuvres. The nature and cause

of the resistance of water. A suggested new form of steam vessel to attain high speed. The navy. Authoritative service opinions.

OCTOBER 19. Sailors' rations—II.

OCTOBER 26. Torpedo-thrower. R. W.

LE YACHT.

JULY 6, 1889. Editorial on the French navy. Discussion on the annual appropriation in the Senate. The manœuvres in the Mediterranean. Review of the merchant marine. The influence of speed in ramming collisions (ended).

JULY 13. Notes from foreign shipyards.

JULY 20. The French manœuvres of 1889. Review of the merchant marine.

JULY 27. The French manœuvres of 1889. The naval exhibit at the Paris Exhibition.

AUGUST 3. Editorial on the annual appropriation of 58,000,000 francs.

AUGUST 10. Remarks on the naval review at Spithead. Review of the merchant marine.

AUGUST 17. The naval exhibit at the Paris Exhibition. Trial trip of the Trafalgar.

AUGUST 24. Editorial on the English manœuvres. The naval exhibit at the Paris Exhibition.

AUGUST 31. The English navy. Modern engines.

SEPTEMBER 7. Notes from foreign shipyards. Review of the merchant marine.

SEPTEMBER 14. The loss of the "Anadyr" and the responsibility of pilots. English squadron manœuvres. A. C. B.

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1890.

Elected at the regular annual meeting, held at Annapolis, Md., October 18, 1889.

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The following amendment to the Constitution, to replace Article XI, Sections 1 and 2, was duly carried according to the forms prescribed in the Constitution, by a majority vote:

SEC. 1. A prize of one hundred dollars, with a gold medal, shall be offered each year, for the best essay on any subject pertaining to the Naval Profession.

SEC. 2. The award for the above-named prize shall be made by the Board of Control, voting by ballot and without knowledge of the names of the competitors; and the time and manner of submitting such essays shall be determined and announced by said Board.

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SPECIAL NOTICE.

NAVAL INSTITUTE PRIZE ESSAY, 1890.

A prize of one hundred dollars and a gold medal is offered by the Naval Institute for the best Essay presented, subject to the following rules:

1. Competition for the Prize is open to all members, Regular, Life, Honorary, and Associate, and to all persons entitled to become members, provided such membership be completed before the submission of the Essay. Members whose dues are two years in arrears are not eligible to compete for the Prize until their dues are paid.

2. Each competitor to send his essay in a sealed envelope to the Secretary and Treasurer on or before January 1, 1890. The name of the writer shall not be given in this envelope, but instead thereof a motto. Accompanying the essay a separate sealed envelope will be sent to the Secretary and Treasurer, with the motto on the outside and writer's name and motto inside. This envelope is not to be opened until after the decision of the Judges.

3. The Judges shall be three gentlemen of eminent professional attainments (to be selected by the Board of Control), who will be requested to designate the essay, if any, worthy of the Prize, and, also, those deserving honorable mention, in the order of their merit.

4. The successful essay to be published in the Proceedings of the Institute; and the essays of other competitors, receiving honorable mention, to be published also, at the discretion of the Board of Control; and no change shall be made in the text of any competitive essay, published in the Proceedings of the Institute, after it leaves the hands of the Judges.

5. Any essay not having received honorable mention, may be published also, at the discretion of the Board of Control, but only with the consent of the author.

6. The Board of Control will accept any essay written upon a subject closely related to the Naval Profession.

7. The essay is limited to fifty (50) printed pages of the Proceedings of the Institute.

8. All essays submitted must be either type-written or copied in a clear and legible hand.

9. The successful competitor will be made a Life Member of the Institute.

10. In the event of the Prize being awarded to the winner of a previous year, a gold clasp, suitably engraved, will be given in lieu of a gold medal.

By direction of Board of Control.

RICHARD WAINWRIGHT,
Lieut., U. S. N., Secretary and Treasurer.

ANNAPOLIS, MD., *February* 8, 1889.

Vol. XV., No. 4. 1889. Whole No. 51.

PROCEEDINGS

OF THE

UNITED STATES

NAVAL INSTITUTE.

VOLUME XV.

PUBLISHED QUARTERLY BY THE INSTITUTE.

ANNAPOLIS, MD.

COPYRIGHT, 1889, BY RICHARD WAINWRIGHT, SEC'Y AND TREAS., U. S. NAVAL INSTITUTE.

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NOTICE.

The U. S. Naval Institute was established in 1873, having for its object the advancement of professional and scientific knowledge in the Navy. It now enters upon its seventeenth year of existence, trusting as heretofore for its support to the officers and friends of the Navy. The members of the Board of Control cordially invite the co-operation and aid of their brother officers and of others interested in the Navy, in furtherance of the aims of the Institute, by the contribution of papers and communications upon subjects of interest to the naval profession, as well as by personal support and influence.

On the subject of membership the Constitution reads as follows:

ARTICLE VII.

SEC. 1. The Institute shall consist of regular, life, honorary, and associate members.

SEC. 2. Officers of the Navy, Marine Corps, and all civil officers attached to the Naval Service, shall be entitled to become regular or life members, without ballot, on payment of dues or fee to the Secretary and Treasurer, or to the Corresponding Secretary of a Branch. Members who resign from the Navy subsequent to joining the Institute will be regarded as belonging to the class described in this Section.

SEC. 3. The Prize Essayist of each year shall be a life member without payment of fee.

SEC. 4. Honorary members shall be selected from distinguished Naval and Military Officers, and from eminent men of learning in civil life. The Secretary of the Navy shall be, *ex officio*, an honorary member. Their number shall not exceed thirty (30). Nominations for honorary members must be favorably reported by the Board of Control, and a vote equal to one-half the number of regular and life members, given by proxy or presence, shall be cast, a majority electing.

SEC. 5. Associate members shall be elected from officers of the Army, Revenue Marine, foreign officers of the Naval and Military professions, and from persons in civil life who may be interested in the purposes of the Institute.

SEC. 6. Those entitled to become associate members may be elected life members, provided that the number not officially connected with the Navy and Marine Corps shall not at any time exceed one hundred (100).

SEC. 7. Associate members and life members, other than those entitled to regular membership, shall be elected as follows: Nominations shall be made in writing to the Secretary and Treasurer, with the name of the member making them, and such nominations shall be submitted to the Board of Control, and, if their report be favorable, the Secretary and Treasurer shall make known the result at the next meeting of the Institute, and a vote shall then be taken, a majority of votes cast by members present electing.

The Proceedings are published quarterly, and may be obtained by non-members upon application to the Secretary and Treasurer at Annapolis, Md. Inventors of articles connected with the naval profession will be afforded an opportunity of exhibiting and explaining their inventions. A description of such inventions as may be deemed, by the Board of Control, of use to the service, will be published in the Proceedings.

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Annual subscription for non-members, $3.50. Annual dues for members and associate-members, $3.00. Life membership fee, $30.00.

All letters should be addressed to Secretary and Treasurer, U. S. Naval Institute, Annapolis, Md., and all checks, drafts and money orders should be made payable to his order, without using the name of that officer.

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